

Electrical Construction and Maintenance

With which is consolidated ELECTRICAL CONTRACTING

AUGUST · 1947

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*Getting
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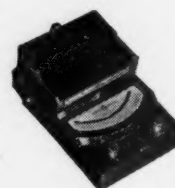
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Extension poles, in four- and six-foot lengths, are available for using the AK-1 on high-voltage circuits, and for reaching into inaccessible places. Also, a cowhide leather carrying case can be obtained for protecting the instrument when it is not in use. For further information, contact your local distributor or your nearest G-E sales office. Write for Bulletin GEA-2950, Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

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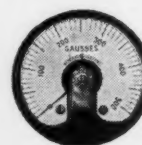
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Electrical Construction and Maintenance

With which is consolidated *Electrical Contracting*,
The Electricist and Electrical Record...Established 1901

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering installations, repairing, maintenance and management, in the field of electrical construction and maintenance.

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ELECTRICAL WIRES AND CABLES "BETTER THAN CODE REQUIRES"

ELECTRICAL CONSTRUCTION and MAINTENANCE. Published monthly. Price 35-cents a copy. Vol. 46, No. 8. Allow at least ten days for change of address. RETURN POSTAGE GUARANTEED. Publication office, 99-129 N. Broadway, Albany 1, N. Y. All communications about subscriptions should be addressed to J. E. Blackburn, Jr., Vice-President (for Circulation Operations), Electrical Construction and Maintenance, 330 West 42nd St., New York 18, N. Y. Subscription Rates—U. S. and possessions, \$3.00 a year, \$4.00 for two years, \$5.00 for three years. Canada \$4.00 a year, \$6.00 for two years, \$8.00 for three years. Pan American countries \$6.00 for one year, \$10.00 for two years, \$12.00 for three years. All other countries \$15.00 a year, \$30.00 for three years. Please indicate position and company connection on all subscription orders. Entered as second class matter August 29, 1936, at Post Office, Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. Copyright 1947 by McGraw-Hill Publishing Company. Cable address: "McGraw-Hill, New York." Member A. B. P. Member A. B. C.

AUGUST at a Glance

Instrument Techniques

Electrical measuring instruments are as old as the science of electricity. While developments through the years have brought great improvements in precision and ruggedness, they are only rarely used to full advantage in the practical everyday work of electrical maintenance. With the conviction that greater use and usefulness of electrical measuring instruments follows on better understanding, we asked Lawrence F. Parachini of Weston to prepare a series of articles. Beginning in this month's Industrial Electrification section, page 101, Parachini describes the various basic types of indicating instruments. You will find it both easy reading and thoroughly useful data.

Security

The building program of the Atomic Energy Commission must be carried on behind a security screen. It involves many contractors, suppliers and manufacturers who must in turn observe the strict security rules laid down by the Commission. Such operations were difficult and irksome under the powerful motivations of war; they will be much more so in peace time. Yet the work is of compelling national importance. It must go on. And its requirements must be expedited without the aid of wartime priority assistance. Private industry must provide wholehearted cooperation to carry out the Commission's projects. There is much at stake. One of these days the military aspects of atomic energy will be controlled. On that day we shall have private business and industrial organizations

all over the country with the know-how and skilled personnel to speed the potential peaceful application of this great new force for the use of the people.

Resort Hazards

In the course of the summer months a goodly share of the folks in this industry take off for some popular vacation spot. If they are like most of us, they give the wiring in their quarters an expert appraisal but rarely complain of even the worst violations. It is about time to speak up. Many of our resort hotels are spiderwebs of lamp cord extensions inviting disaster. In some cases managers are unaware that such wiring is dangerous and, since many resorts are usually remote from urban areas, have never heard of electrical inspection or the National Electrical Code. It's time they knew. And if we don't tell them, who will?

Louver Ceilings

One of the most interesting and challenging types of lighting schemes finding application today is the Louverall ceiling. Lamps and reflectors are mounted above a suspended louver ceiling covering the entire area or the principal area of the room. Most famous is the council auditorium of the United Nations at Lake Success. Such ceilings allow a wide choice of lighting equipment layout. However, there are optimum spacings and arrangements for specific results. Charles L. Amick of Nela Park presents authoritative data on the Louverall ceiling on page 57 of this issue.

Show Tickets

Over on page 130 in the Modern Lighting department, you will find a coupon. Send it in to us for your tickets to the 2nd International Lighting Show—to be held in Chicago November 3-7. We'll have a booth there and most of our editors will be milling around welcoming old friends and making new ones. Be sure to stop by and see us.

Labor Law

However interesting, or controversial, the broad labor management policy aspect of the Taft-Hartley bill may be, it is law. And its provisions must be adapted to the prosaic chores of daily business. We asked Joe Gambatese to tell us just how the new law works in construction. Gambatese, experienced labor editor and journalist of McGraw-Hill's Washington Bureau, has followed the development of the law through first hand contacts with leaders in government, labor and business. You will find his appraisal on page 60 and a last minute follow up on page 135.

Signal Wiring

How does the 1947 Code affect wiring for fire alarms, intercommunication systems, clock systems, and the like? We learned that Edward S. Ruth, chief engineer of Edwards and Company, had made an unusually comprehensive analysis for his own organization. Whipped into shape for publication, it gives us as precise and factual appraisal of the special code problem in this field as we have seen yet. It is titled, "The Code on Signals" and begins on page 63.

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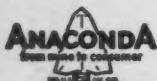
Week in and week out, overtaxed, overextended, obsolete wiring can tax plant efficiency 25 to 50 percent without detection until a major tie-up occurs.*

To remove this costly imposter from your payroll, call in your plant power engineer, your consulting engineer, electrical contractor or utility power salesman. These men can find his finger prints anywhere in the plant.

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CONSTRUCTION COSTS

THERE IS no more compelling problem before the construction industry today than the urgent need for reducing costs of unit operations. The problem is both technical and administrative. It has the attention of many industry leaders. Unquestionably, there will be real progress in this direction in the coming years. There must be if the industry is to prosper.

IN THE PRESS, on the radio and even in the President's economic report there is, unfortunately, a rising tide of propaganda directed against the price of construction. We say propaganda because much of it is badly distorted. Claims are supported by more or less authentic anecdotes in an industry so vast and complex that any curious observer could readily support almost any hypothesis simply by his choice of anecdotes.

THE CURRENT CRITICISM implies that great savings on individual structures will automatically proceed from the correction of alleged abuses or improved efficiencies. Obviously true. But by what order of magnitude? Is it 2, 5, 10, 25, or 50 percent? The commentators are silent on this point. The lay reader fills it in himself, usually on the high side.

ON THE OTHER HAND, we have a rising public pressure for more and better mechanical and electrical features in our building. This is aided and abetted by powerful advertising and sales promotion campaigns. Floor coverings and fluorescent lighting, aluminum sash and electronic heat controls, for example, are on the march. And the construction industry will foster and support similar developments at an ever increasing tempo. Each new facility or device usually means a rise, however slight, in the price per cubic foot of the finished structure.

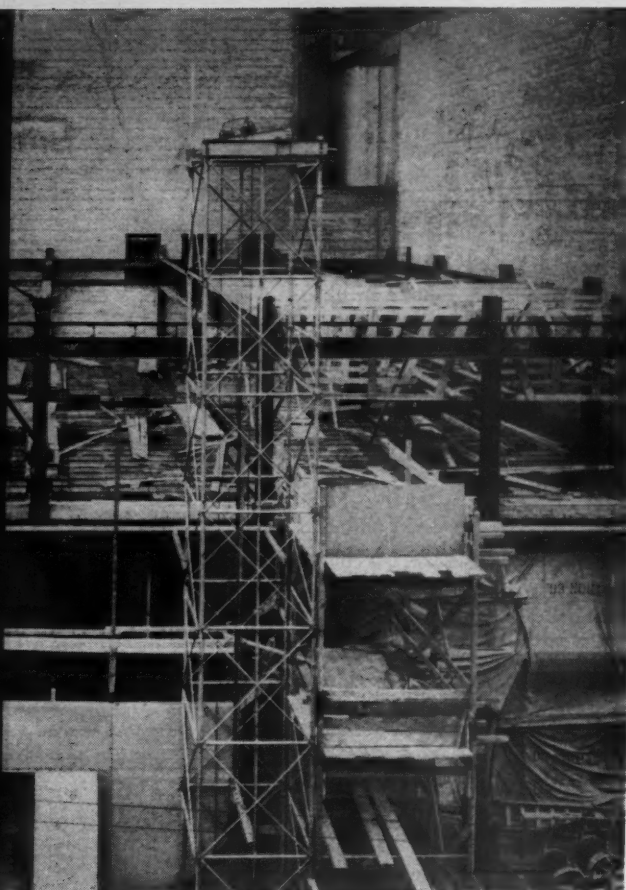
BY AND LARGE, the men responsible for building appropriations are not familiar with the technical and administrative aspects of the construction industry. They are boards of directors, bankers, merchants, legislative bodies or home buyers. They are consciously or unconsciously persuaded by the current criticism of construction practices and policies, to defer needed appropriations and decisions until prices come down.

THE PLAIN and realistic facts are that prices won't come down short of a major depression. When the construction industry gets control of its costs and tackles job efficiency, there will be notable economies, but these will be more than offset by expanding electrical and mechanical facilities. Postponing building may achieve greater values. It will not bring lower prices.

IT SEEMS TO US that every man in the construction industry ought to make his voice heard during this critical period. Government bodies need his experienced wisdom. His understanding of building technology is essential to the deliberation of civic organizations. In all the talk about construction costs, his is the voice heard least, yet he is the only one who knows what it is all about.

Wm. J. Stuart

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you're
going to
wire ...



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Fig. 1—Perhaps the most famous louverall systems today are in the council auditoriums of the United Nations, Lake Success, N. Y. The lighting of this previous industrial space consisted of continuous-row 100-watt RLM fluorescent units on 13-foot centers. Fixtures were rewired with ballasts for the 40-watt T-17 low-bright-

ness lamps, a flat cover plate substituted for the reflectors, and rows relocated on 5-foot centers. Louverall sections $2\frac{1}{2}$ by $5\frac{1}{2}$ feet in size with cells $9\frac{1}{2}$ by 10 inches and 6 inches deep were hung 13 inches below the lamps on runners made from angle iron. The system provides 50 footcandles in service.

LOUVERALL CEILINGS

A New Lighting Technique

TABLE 1—Approximate Utilization Factors for Louverall Installations with White Ceilings*

Wall Reflection Factor	50%	30%	10%
Room Index			
J	.25	.24	.22
I	.29	.28	.27
H	.31	.31	.30
G	.33	.33	.32
F	.34	.34	.33
E	.36	.35	.34
D	.37	.37	.36
C	.38	.37	.37
B	.39	.38	.38
A	.40	.39	.38

* For installation conditions close to those simulated in the tests: Continuous channels with fluorescent lamps on 30-inch centers and 6 inches above an etched aluminum louver with 3 x 6 x 3-inch cell providing 45° crosswise shielding and 27° lengthwise shielding.

A discussion of design and application procedures, including new and authoritative data on spacing of louvers and lamps, shielding and system efficiencies.

By Charles L. Amick

Lamp Department, General Electric Company,
Nela Park, Cleveland, Ohio

ONE of the interesting systems used for general or specialized interior lighting recently is the technique of providing both crosswise and lengthwise shielding of fluorescent lamps by covering the ceiling with louvers suspended below the lamps. Such an installation can offer exceptionally comfortable illumination, with a "clean" ceiling which approaches the goal of inconspicuous lighting. This method

(Fig. 1) is popularly called "Louverall" lighting.

A lighting treatment of this type has features of flexibility and versatility which will frequently appeal to owner, architect and electrical contractor alike. A limitation of some illumination systems has been the relative difficulty in making any substantial alteration after the original installation. With louverall, groups of lamps



Fig. 2—The first louverall installation for general lighting—the Round Table Room of the G-E Lighting Institute at Nela Park, Cleveland. Installed in 1939, the system consisted of 44 40-watt daylight fluorescent lamps in abutting Alzak reflectors covering the area above the louverall sections.

cific merchandise displays in stores and louverall systems can be utilized to help conceal pipes, ducts and other unsightly elements on or near the ceiling.

Actually, the plan of building special louver elements or of utilizing existing beams and other architectural features to improve the comfort of a lighting installation is not a new one. The evolution is familiar to many in the electrical construction and maintenance industry. Enclosing globes were virtually the standard lighting fixture 20-30 years ago but as illumination levels rose to about 20 footcandles or more their brightness was distractingly high. Indirect lighting raised the footcandle level with comfort to around 40-50—above that comfort diminished noticeably because the ceiling became too bright. One remedy suggested was that false beams be employed to break up the expanse of uncomfortably bright ceilings in large indirectly lighted interiors. Coffers received increasing attention for the same reason. In 1939 the first louverall installation, a flexible system providing up to 200 footcandles of comfortable lighting, was installed in a conference room of the G-E Lighting Institute at Nela Park, Cleveland, Ohio (Fig. 2).

Louverall is still a relatively new technique, and in its simplest form

consists of fluorescent-lamp channels mounted on the ceiling with separately fabricated sections of louvers suspended below. However, many variations are possible such as mounting the louvers flush with the ceiling, suspending lamps from the ceiling, from irregular shaped louvers, etc. Accompanying illustrations show contemporary louverall installations. The distance between the louvers and the height of the "blade" determines the degree to which lamps are shielded from view by occupants of the room.

In applications such as offices and schools where the visual tasks are critical and prolonged, the louvers should shield the broadside view of fluorescent lamps through an angle from horizontal down to 45 degrees. The tube brightness is lower when the lamps are seen lengthwise, so shielding down to 30 degrees is acceptable for that direction. Shielding requirements can be less for low-brightness fluorescent lamps, such as the 40-watt T-17 size and Slimline lamps operated at 100 or 120 milliamperes. There is more latitude in stores because the shoppers are on visual explorations which do not involve concentration for long periods. Considerations of atmosphere, styling, and distraction from the merchandise usually dictate the appropriate shielding angle for different types and classes of stores.

For interiors where people face in all directions, the size of the louvers to conceal the lamps in a given angle is a matter of geometry alone. If strips four inches deep were installed on 4-inch centers in both directions, the lamps above would be obscured to 45 degrees below horizontal. If

can be switched on separately, giving a room appearance superior to an installation of conventional fixtures, some on and some off if several levels of illumination are desired. Future increases in illumination can be secured by adding rows of lamps. Louverall lighting need not have a flat appearance—pleasing brightness patterns in the louver itself are achieved by selecting certain spacing relationships, and by the use of reflectors. Colored lamps can be employed to create pleasing color combinations on the louver surfaces and still give essentially white light in the room itself. Filament-lamp spotlights can be mounted above the louvers to produce added footcandles that give extra attraction value to spe-

TABLE 2—Spacing Between Continuous Rows for Louverall Installations*

Footcandles	35			50			75		
Utilization	.20	.30	.40	.20	.30	.40	.20	.30	.40
Lamp	Inches Between Continuous Rows								
40-Watt									
48-inch T-12	23	35	47	16	25	33	11	16	21
60-inch T-17	19	28	37	13	20	27	9	13	17
100-Watt									
60-inch T-17	36	54	71	25	37	50	17	25	33
Slimline									
96-inch T-8 at 200 ma.	17	26	34	12	18	24	8	12	16

* Using 4500° White lamps. Footcandles are average in service, based on a maintenance factor of 0.65.

TABLE 3—Lamp to Louver Distance to Obtain Approximately Uniform Louver Brightness*

Footcandles	35			50			75		
Utilization	.20	.30	.40	.20	.30	.40	.20	.30	.40
Lamp	Inches from Lamp Center to Top of Louvers								
40-Watt									
48-inch T-12	15	23	31	11	17	22	8	11	14
60-inch T-17	13	19	25	9	13	18	6	9	11
100-Watt									
60-inch T-17	24	36	47	17	25	33	11	17	22
Slimline									
96-inch T-8 at 200 ma.	11	17	23	8	12	16	5	8	11

* The lamp to louver distances in this table is 2/3 the row spacing in Table 2.

the same strips were eight inches apart giving cells of 8 by 8 by 4 the shielding would be the angle whose tangent is $4/8$ or about 27 degrees. However, large "cells" can give the same shielding as small cells if the cut-off angles are the same. For example, 12 by 12 by 12 cells and the 4 by 4 by 4 cells both provide 45 degree shielding in either direction. A 6 by 10 by 6 cell gives 45° crosswise and 30° lengthwise shielding if the blades on 6-inch centers are parallel with the rows of lamps. The louvers in effect become the ceiling, giving the feeling of reduced ceiling height, but in a degree depending on the size of the cell and the room dimensions. Form and dimensions of louvers must also be considered with reference to the general architectural and decorative treatment.

There are many combinations of louver size and shape, spacing and type of light source, louver-to-lamp distance and louver finish. Studies now being made will ultimately result in information with which louverall installations can be accurately planned. Tests made with a louver section $2\frac{1}{2}$ by 6 feet under conditions which simulate those of an actual louverall installation give the utilization factors for different room proportions shown in Table 1. Such data should be used to estimate louverall utilization factors until more precise values are available. The factor is, of course, affected by the finishes of the surfaces above the lamps and louvers. In the usual case, these surfaces should be white.

The number of lamps needed above the louver to produce a given foot-

Fig. 3—A louverall installation described in the February 1947 issue of Electrical Contracting is in the TWA office, Chicago. Twenty-nine continuous rows of 6- and 8-foot 4500° White Slimline lamps on approximately 2-foot centers are shielded by aluminum-bar louvers.

candle level in service depends on (1) the proportion of light emitted by the lamps which reaches the work plane (utilization factor) and (2) the rate of dirt accumulation, and lamp depreciation and cleaning frequency. Table 2 gives the spacings of continuous single rows of different sized 4500° White fluorescent lamps to give 35, 50, and 75 footcandles in service, based on a maintenance factor of 0.65. For 3500° White lamps the spacings can be increased about 10 percent for the 40-watt T-12 lamp and 5 percent

[Continued on Page 85]

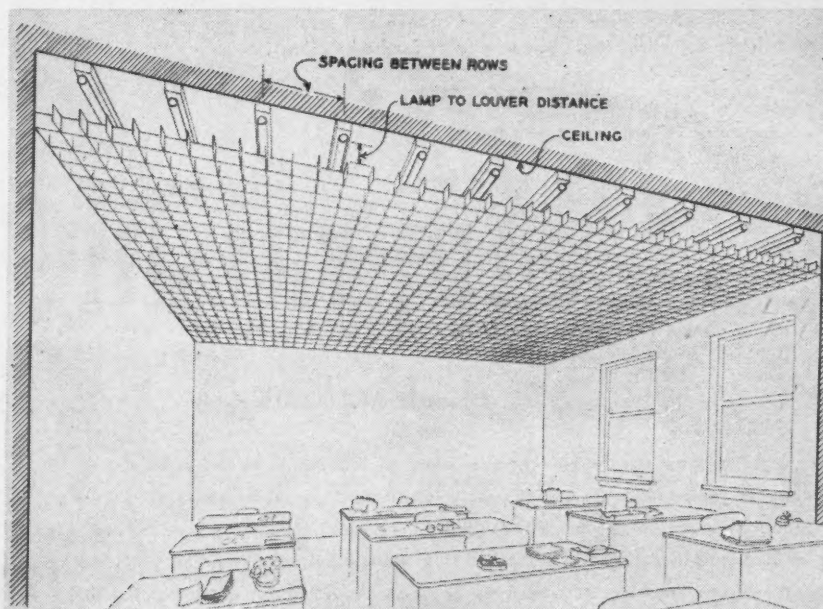


Fig. 4—The principle of louverall construction. This illustrates perhaps the simplest form of louverall—fluorescent lamp channels mounted on the ceiling with separately fabricated louver sections suspended below.

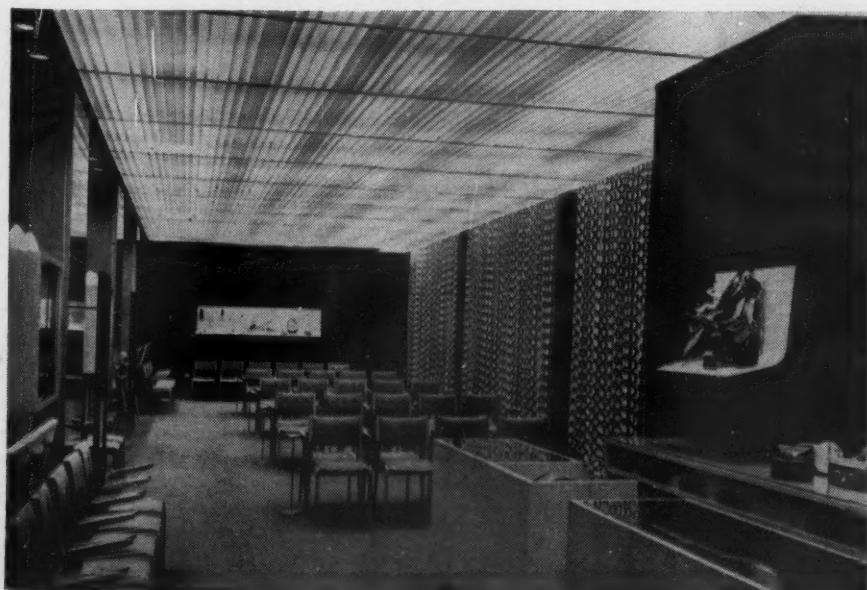


Fig. 5—This Florsheim shoe store at 516 Fifth Avenue, New York City, is lighted with 150 40-watt fluorescent lamps in single-lamp continuous channels about $2\frac{1}{2}$ feet apart. A total of 260 louver sections, 2 x 4 feet each, cover the ceiling and the individual cells are 3 by 3 inches and $2\frac{1}{2}$ inches deep. The illumination level in service is 45 footcandles and the coefficient of utilization estimated at 0.26. Had the ceiling and side walls above the louver been white instead of black the utilization might have been of the order of 0.38-40.

UNFAIR LABOR PRACTICES

- - - By Unions - - -

The Wagner Act held only *management* accountable for unfair labor practices. To make the Taft-Hartley law a two-way street, Congress classified these *union* practices also as unfair:

1. Restraining or coercing employees.
2. Causing or attempting to cause an employer to discriminate against an employee, except as permitted by the regulated union shop.
3. Refusing to bargain with an employer.
4. Conducting a strike or boycott aimed at forcing an employer to (1) join a union or employer association, or engage in a boycott; (2) bargain with an uncertified union (the secondary "organizing" strike); (3) deal with one union if another union has been certified (jurisdictional dispute); or (4) assign work to a particular union or craft (also jurisdictional).
5. Charging an excessive fee when employees are required to join the union.
6. Exacting from an employer money for services which are not performed (some forms of featherbedding).

UNFAIR LABOR PRACTICES

- - - By Employers - - -

The Taft-Hartley law retains the five unfair labor practices chargeable against management under the Wagner Act, except for the new ban on the closed shop. They are:

1. Interfering with, restraining or coercing employees as to their rights under this law.
2. Dominating or giving aid to a union.
3. Encouraging or discouraging union membership, except that an employer may make an agreement requiring union membership as a condition of employment (30 days after hiring) if the union is certified and a majority of all employees in the bargaining unit vote for it in a NLRB election. Further, the employer may not discriminate for non-membership if the employee involved was discriminated against by the union or is not a member for reasons other than non-payment of dues or initiation fees.
4. Discriminating against an employee for filing charges under this law.
5. Refusal to bargain.

Appraising the NEW

by Joseph M. Gambatese

Management and labor alike must now adapt their relations to the provisions of the new law or suffer severe penalties. Many practices common and even traditional in the electrical construction industry may have to be altered. To give you a better understanding of the law as it affects this industry, we asked Joe Gambatese, distinguished labor editor and reporter of our Washington Bureau to appraise those aspects of the bill which are of particular interest to you. From a background of close personal contact with congressional, labor and management leaders during preparation of the bill and since its passage, he has given us this clear, objective report.—Editor

RELATIONS between reasonable employers and reasonable union leaders in the electrical construction industry won't turn topsy-turvy because of the Labor Management Relations Act of 1947.

In the Taft-Hartley labor law, as it is called, the government seeks for the first time to impose a measure of responsibility on labor unions commensurate with their increased power and influence. It recognizes the individual rights of employees, as distinguished from union rights, and the rights of employers to manage their business.

The Wagner Act's one-sided rules

against employers are matched by a like number of curbs against unions. The country's new labor policy now cuts both ways, with pitfalls and penalties facing both unions and employers. New rules are set up, and it is the duty of both sides to follow them.

What are these rules? How do they affect the business of electrical construction and maintenance.

The Taft-Hartley law gives particular attention to three conditions existing in the industry:

1. The closed shop.
2. Boycotts and jurisdictional strikes.
3. Pensions.

The closed shop and preferential hiring are banned. If certain conditions are met, employers may sign a union shop or maintenance of membership contract, provided they are not in one of the 13 states which ban all degrees of compulsory membership. The Taft-Hartley law gives precedence to state anti-closed shop laws which go beyond the federal restriction.

The union shop probably will replace the closed shop in the construction industry, so employers should be aware of their responsibility under it. The new law requires:

1. The union may not seek a union shop until 30 percent of the employees who would be covered have petitioned the National Labor Relations Board for poll.

2. The employer may *not* grant a union shop unless a majority of all the employees eligible to vote (not just those who vote) approve. Even then, the employer is not compelled to sign a union shop, although a heavy vote in favor of it would make it more difficult for him to resist.

3. The union shop requires all employees to join the union, but there

LAW'S TEETH

No powderpuff is the Taft-Hartley law. It has stiff penalties. They apply to employers as well as unions, to officials of companies as well as unions, and in some cases to individual workers.

Some of them:

Damage suits: Against either side for breach of contract; against unions for jurisdictional strikes and boycotts.

\$5,000 fine and/or one year in prison: Against any person for interfering with this law.

\$10,000 fine and/or ten years in prison: Against any union official who makes a false affidavit regarding Communist sympathies.

\$10,000 fine and/or one year in prison: Against any person for violating restrictions on union welfare fund contributions, checkoff, and other payments by employers to union representatives.

\$5,000 fine: Against any corporation or union making an "expenditure" in connection with any political campaign for federal office.

\$1,000 fine and/or one year in prison: Against any corporation official or union official who consents to such a political expenditure.

Loss of jobs: By federal employees who strike.

Loss of employee status: By employees who strike before expiration of the 60-day waiting period.

LABOR LAW

How the "Taft-Hartley" law affects relations between employers and employees in the electrical construction industry.

must be at least a 30-day period after hiring or after signing of the agreement before the employee can be forced to join.

The employer's responsibility does not end with the signing of the union shop. During its lifetime, he cannot discriminate against a worker for non-membership if he "has reasonable grounds for believing" that the union discriminated against the worker as to admission. Nor can the employer discharge a worker for non-membership if the union expelled him for reasons other than failure to pay dues.

What does this mean? It means that an electrical contractor cannot dismiss an employee for not joining the union, even though the union shop contract might call for it, if the contractor knows, for example, that the union discriminated against him either by refusing to admit him, by raising the initiation fee or dues, or perhaps by offering him only a "second class" membership.

The "B" classification in the International Brotherhood of Electrical Workers would be considered discriminatory in that the members do not

have equal voting rights, with Class A locals in convention or in referendums. This may not be a problem, however, because by action of the IBEW convention last September a new "BA" classification has been established to which all "B" locals may convert. The "BA" locals differ from the "A" locals in that, while they have equal rights and privileges, they do not contribute to or share in the union's Pension Benefit Fund.

The IBEW insists that participation in the pension plan is optional. If that is true, the "BA" classification would appear not to be discriminatory.

Under the new law, a union may expel a member for being a Communist, for violating union rules or for any other reason its rules permit. But an electrical contractor could not be compelled to dismiss him unless it was for non-payment of regular union dues.

Thus, unions may make their own rules of admission and expulsion, but they may not under a union shop force the dismissal of a worker for non-membership if he is either discriminated against as to admission, is not

given the same privileges as other union members, or is expelled for reasons other than failing to pay dues.

The law also makes it an unfair labor practice for a union holding a union shop to charge an excessive fee. In determining whether a fee is "excessive," NLRB will consider the practice of other unions in the industry and the wages being paid the employee.

These rules for a union shop apply equally as well to a maintenance of membership contract. This type of contract, more common to manufacturing than to construction, makes union membership optional, but workers who join may not resign.

Employers are free to hire whom they wish, irrespective of union status, but they may not favor either union or non-union jobseekers.

As a practical matter in the electrical industry, however, employers may find that the only competent journeymen available in their area are members of the union. It is not discrimination to reject a non-union applicant if he is not qualified either.

Thus, in many areas closed shop conditions may prevail, but they cannot be

enforced by a contract. An employer, for instance, may refuse to hire an expelled member of the IBEW because he is a trouble maker or otherwise undesirable. But he can't refuse to hire him merely because he doesn't carry a union card.

Trouble can be expected, however, when a contractor dealing with the IBEW hires a journeyman who is not a member. He will find IBEW members unwilling to work with him; they may label it an "undesirable working condition."

Closed shop contracts existing on June 23, when the law was enacted, may continue until they expire. Those instituted or renewed after June 23 and before Aug. 22 may run for a year. None may be signed or renewed beginning Aug. 22.

The Taft-Hartley law also kills the automatic checkoff. As of June 23, it has been illegal to sign or renew a checkoff unless it provides for voluntary, written authorization from each individual worker. Existing compulsory checkoffs may continue until they expire, but not beyond next July 1.

The apprenticeship program probably will not be affected by the new law. Employers will be free, as they are now, to hire whom they please as an apprentice. Union rules as to admission and training of apprentices are not affected.

Boycotts and Jurisdictional Strikes

Boycotts and jurisdictional strikes not only are declared by the new law to be unfair labor practices, but they have been defined as "unlawful combinations" exempt from the protection of the Norris-LaGuardia Act. Employers may seek injunctions against them through NLRB, which is obligated to give these matters priority over all other types of cases. Anyone injured by reasons of a boycott or jurisdictional strike may sue for damages in a federal district court.

Conditions in parts of the electrical industry were largely responsible for the curb on boycotts and contributed to the ban on jurisdictional disputes.

Robert S. Edwards, president of the National Electrical Manufacturers Assn., testified before the Senate labor committee regarding the IBEW boycott against CIO-made and non-union electrical products and Local 3's monopoly on the manufacture, distribution, installation and maintenance of all electrical-construction materials in the New York area.

The attention of Congress was

called, also, to the Supreme Court's decision in an electrical case of two years ago. This decision held the manufacturer and the union guilty of violating the Sherman Antitrust Act because they acted together. However, because of the Clayton and Norris-LaGuardia Acts, the court said, it would be perfectly legal for the union alone to engage in restraint of trade.

The Taft-Hartley law now removes this protection for the union. "Whoever" is injured by a boycott may sue for damages.

Specifically, the law sets up four practices as "boycotts and other unlawful combinations." It makes it an unfair labor practice and also unlawful for a union to engage in a strike or refusal "to use, manufacture, process, transport, or otherwise handle or work on any goods, articles, materials, or commodities or to perform any services," where the object is:

1. To force an employer or self-employed person (a) to join a union or employer association, (b) to cease using or handling another's products or (c) to cease doing business with another.

2. To force another employer to bargain with a union that has not been certified by NLRB.

3. To force an employer to bargain with a particular union when another union already has been certified as bargaining agent.

4. To force an employer to assign work to a particular union, trade or craft.

No. 1 would deny the IBEW any right to force an employer, for instance, to join a NECA chapter or a building trades employer association.

Nos. 2 and 3 prohibit the IBEW from boycotting the products of an employer in order to force him to recognize the IBEW as bargaining agent of his employees.

No. 4 applies to jurisdictional disputes. NLRB is empowered to settle these.

All unfair labor practices, including the above, may be enjoined by the courts at the request of NLRB.

Pensions

The Taft-Hartley law subjects employers to penalties if they contribute to a union welfare or pension fund which does not meet certain specified conditions. This was aimed to scuttle efforts of John L. Lewis to obtain control of a welfare fund from soft coal operators for members of the United Mine Workers. It will have no effect

on the National Electrical Benefit Fund effective since May 5 between NECA and the IBEW.

Laurence W. Davis, executive secretary-treasurer of the fund, has notified all parties that the fund meets all the requirements of the new law in these respects:

It is for the benefit of the employees and their families; it is a trust fund; the purposes of the fund are specified in writing; it is jointly administered; it provides for a neutral person to settle disputes; annual audits will be made, and the funds will be used for no other purpose than the payment of pensions and annuities.

By mid-July, 53 area boards to administer the fund locally had been established. Organization of eight more, which would complete coverage of the entire country, was in progress. They consist of three union, three NECA and one public representative.

A 15-member board, with Dr. Edwin E. Witte, former public member of the National War Labor Board, as chairman, administers the fund nationally. E. C. Carlson of Youngstown, Ohio, Chairman of NECA Labor Relations Committee, is chairman and Daniel W. Tracy, international president of IBEW, vice chairman.

Members of the union contribute 60 cents a month to the fund. This is matched by the employer through a one percent payroll assessment, which goes into the fund. The union member becomes eligible for a \$50 monthly pension at age 65 if he has had 20 years' continuous membership.

Sixty-day notice of a contract termination or amendment must now be given to the other party to a contract, and a 30-day notice to the new Federal Mediation and Conciliation Service. Strikes during the 60-day period are "wildcat" and the strikers subject to loss of job rights. This will not be a problem in electrical construction, which has been virtually strike-free. The "Council on Industrial Relations" which has settled more than 50 disputes in the industry since 1920 will continue to function.

Employers, union leaders, lawyers, members of Congress, labor relations experts and even labor writers all have their views as to what the new law means. The NLRB will make decisions. So will the lower courts. But nobody will be sure of their position until the Supreme Court has spoken. This will consume months, if not years.

It took two years to prove the Wagner Act was constitutional. And it took 12 years to amend it.

THE CODE ON SIGNALS

By Edward S. Ruth

Chief Engineer
Edwards and Co.

How the 1947 National Electrical Code applies to signalling and communication systems.

CODE requirements for signalling and communication system wiring are given in new Article 725 and revised Article 800 of the 1947 edition of the National Electrical Code.

The new Article 725, which did not appear in the 1940 edition of the Code is entitled "Remote-Control, Low Energy Power and Signal Circuits". This article applies to the wiring of the following equipment:

Signal Circuits

- Telephone systems
- Annunciator systems
- Bell, buzzer, horn, chime, systems
- Paging systems
- Hospital systems

Remote-Control, Low Energy Power Circuits

- Clock systems

Article 725 covers two basic classifications of systems referred to as Class 1 circuits and Class 2 circuits. The following types of circuits would come under Class 2:

1. Circuits of not over 60 volts operated from dry batteries or from storage batteries rated at not over 30 ampere-hours at the 8 hour rate (no fuses required).

2. Circuits of not over 30 volts operated from a high reactance control transformer or bell ringing transformer of not over 100 volt-ampere capacity in which the short circuit current does not exceed 6 amperes (no fuses required).

3. Circuits operated from storage batteries rated in excess of 30 ampere-hours at the 8 hour rate not exceed-

ing 15 volts and fused at not more than 5 amperes.

4. Same as 3 above, but not over 30 volts and fused at not over 3 amperes.

5. Same as 3 above, but not over 60 volts and fused at not over 1½ amperes.

6. Circuits operated from transformers of the heavy duty signaling type, not exceeding 100 volt-ampere capacity, up to 15 volts and fused at not over 5 amperes.

7. Same as 6 above, but not over 30 volts and fused at not over 3 amperes.

8. Same as 6 above, but not over 60 volts and fused at not over 1½ amperes.

9. Circuits operated from dry batteries, storage batteries or transformers of up to 100 volt-ampere capacity, not over 150 volts, but provided with a lamp or resistance in the common leg to prevent over 1 ampere on short circuit and fused at not more than 1 ampere.

You will note that Class 2 circuits do not necessarily require fuses (except as specified above) and that wires can be open (not in conduit) and almost any type of wire can be used. The only other limitations specified for the above listed circuits are that the wires of Class 2 remote control and signal systems shall not approach nearer than 2 in. to any electric light or power wires unless separated by a continuous non-conductor in addition to the insulation on the wires. (This ruling refers particularly to

old buildings having knob and tube type light and power wiring). Further, the wires of Class 2 remote control and signal systems shall not be placed in the same raceway, compartment, outlet box, junction box or similar fitting with conductors of Class 1 remote control and signal circuits or light and power circuits, unless the conductors of the two systems are separated by a partition; except in such cases where the light and power wires are introduced solely for power supply to the remote control or signal circuits. Also, wires of Class 2 systems in vertical runs shall have a fire resistant covering sufficient to prevent the carrying of fire from floor to floor, unless encased in non-combustible tubing or located in a fire proof shaft having fire stops at each floor. The primary of transformers used as a power supply for Class 2 remote control and signal systems shall be fused at not over 15 amperes.

Class 1 control and signal circuits are circuits in which the power is not limited as specified for Class 2 circuits. There is no limitation placed on the system voltage or current, but the wiring must be in accordance with light and power wiring requirements (that is, in conduit).

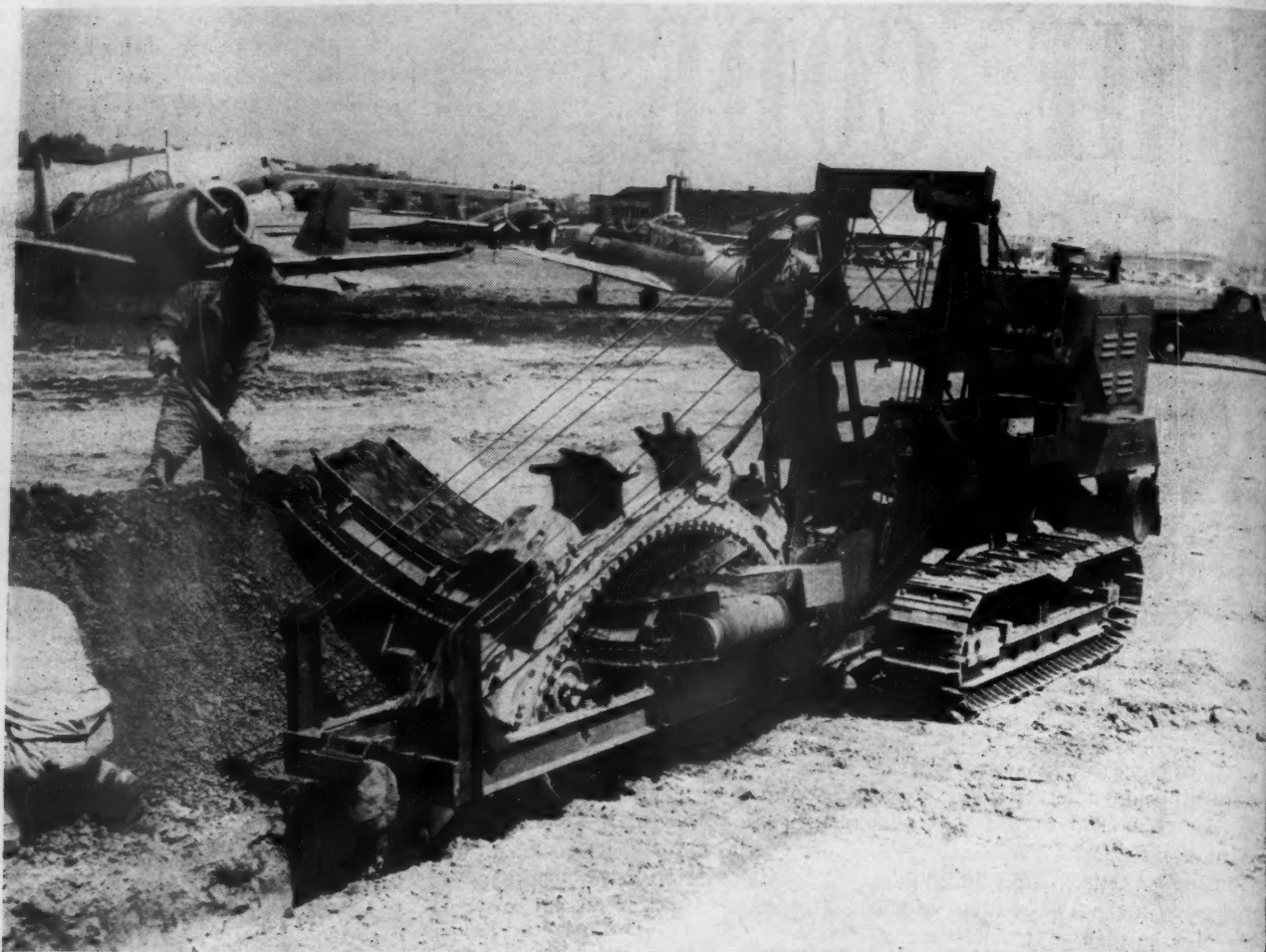
The following exceptions to light and power wiring requirements are permitted for Class 1 control and signal circuits:

1. No. 18 and No. 16 gauge conductors may be used provided they have an insulation at least equal to that of Type RF-32 rubber covered or Type TF thermoplastic covered fixture wire.

2. Conductors of Nos. 18 and 16 are considered as protected by a fuse of not over 15 amperes except in signal circuits where No. 18 gauge conductors must be fused at not over 3 amperes. In other words, in Class 1 remote control, low energy power circuits (a clock system, for example) branch or section conductors as small as No. 18 gauge may be used, and they need not be individually fused if the common feed wire is fused at not over 15 amperes. In Class 1 signal circuits, branch or section wires of No. 16 gauge need not be individually fused if the common feed wire is fused at not over 15 amperes, however, No. 18 gauge wires in Class 1 signal circuits must be protected by a 3 ampere fuse.

3. If the operating voltage of a Class 1 control or signal system does

[Continued on page 158]



Continuous method of installing trench-lay series circuits for runway, range and taxiway lighting units maintained maximum safety conditions for plane landings and take-

offs. Tractor-treaded rotary bucket machines cut trenches. Bulldozers pushed earth back into trenches. Pneumatic tampers re-established firm, compact surface.

Wiring for SKYWAY

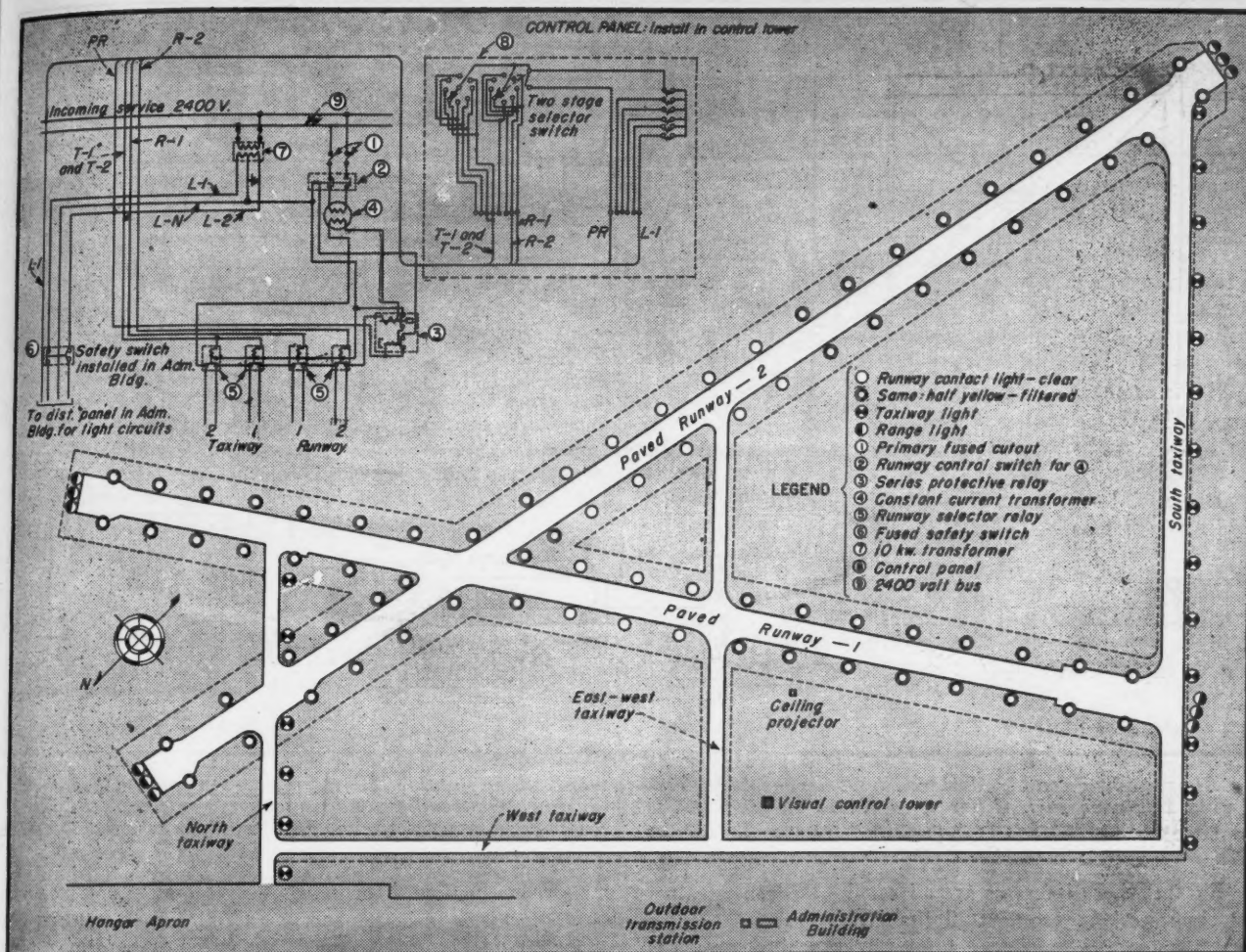
TO adequately handle the expanding volume of air traffic, the recently-submitted National Airport Plan recommends that 1600 of our present 3000 airports be improved through the appropriation of public funds and that 3000 additional fields be constructed. In outlining a billion dollar program, the Plan allocates \$55 million for lighting and related electrical essentials. This amount will be swelled by State and Municipal appropriations, by companies financially interested in the utilities and services related to flying, and by private investment. In the belief that promoting safety of the skyways is as much a public responsibility as safeguarding the nation's highways,

widespread attention is being focused on adequate lighting, control and protection of both air strips and air lanes.

Teterboro Air Terminal, located six miles west of the George Washington Bridge on New Jersey's dual highway Number 6, typifies the air industry's dynamic development and is an outstanding example of the tremendous growth now being recorded at many of the country's privately owned and privately operated fields.

Since the field is primarily designed for servicing planes, handling air freight, planes chartered for unscheduled flights, flight training schools and private flying, activities at Teterboro receive less publicity than other

metropolitan airports devoted to scheduled passenger traffic. Yet activity is great! Already rated as one of the world's busiest air freight terminals, the field will handle over 200,000 tons of air freight during the current year. Average daily plane movements (landings and takeoffs) are already above the thousand mark and a recent record high of 1600 surpassed the traffic handled at New York's giant La Guardia Field during the same day. Stressing utility rather than glamour, the value of the field is concentrated in service and safety—a program in which lighting for night flying plays an important part. Officially listed as a Class 3 airport, the field is served by two-way



Runway, range and taxiway lights, served by separate series circuits, are controlled through two-way selector switches in tower. Primary current at 2400 volts is

transformed to 240/120 volts for field lighting and is maintained at 6.6 amps. by constant current regulator. Field remained in continuous use during installation.

SAFETY

By Hugh P. Scott

Distribution system of Teterboro Air Freight Terminal typifies increasing national attention to lighting standards and provisions for safe night flying.

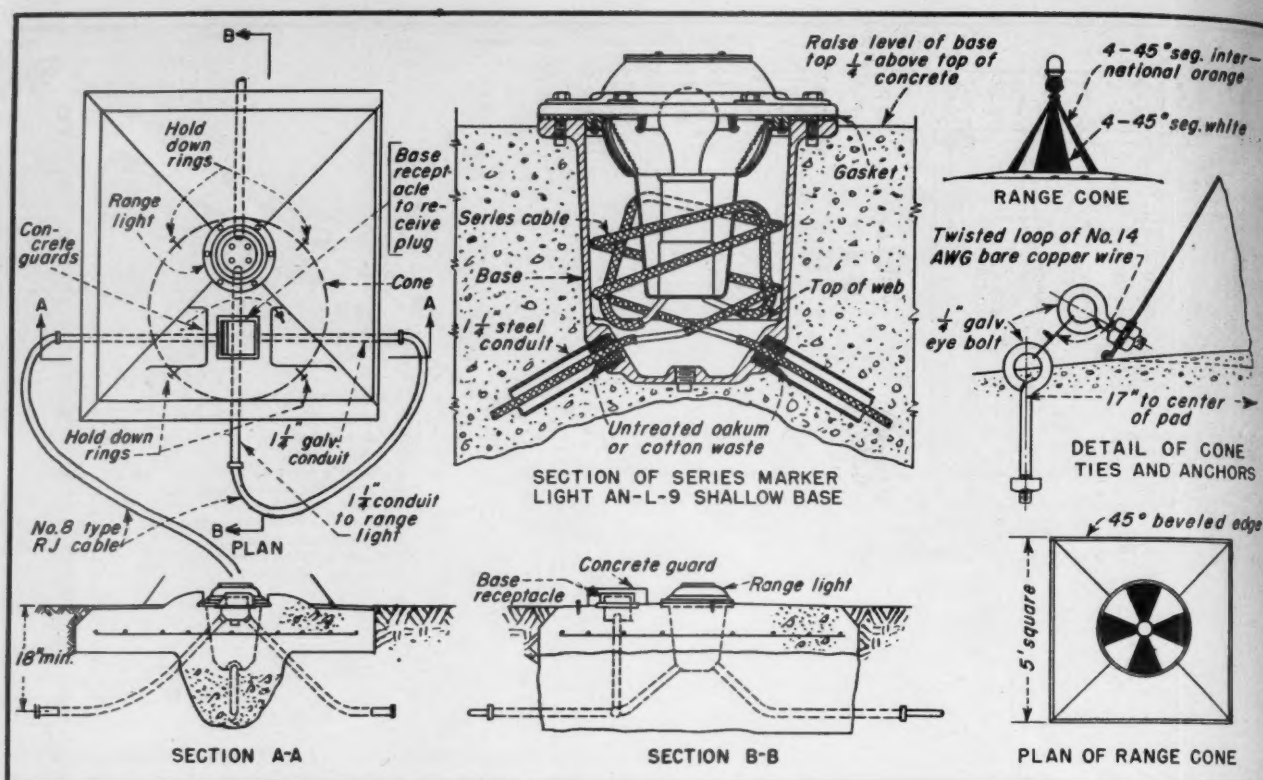
radio, wind and weather recording instruments, additional Weather Bureau information service, visual traffic control tower, field lighting, fueling provisions, hangars, service shops, an administration building, adequate parking space and an excellent drainage system. Lighting includes runway and taxiway contact units, range lights, central beacon, field and apron floodlights, wind tee, ceiling projector, boundary and obstruction lights. All

lighting is in accordance with CAA standards.

In connection with the extension of runways and the installation of new taxi strips, Electrical Contractor A. Neri of Hoboken, New Jersey, was selected to install additional trench-lay series circuits, install extra contact lights, relocate range units and extend the entire distribution system for a relocated control tower and the added electrical field facilities. In perform-

ing this work, the contractor furnished all necessary conduit, nipples, connections, wire, splice and junction boxes, compound, concrete, reinforcing steel, wooden frames, crushed stone and steel supports. To maintain continuity of flying conditions, new contact and range lights were completely installed before old units were disconnected and removed.

All runway, taxiway and range units are designed to include AN-L-9 shallow base series marker lights, although color and distribution characteristics of lenses, details of the reinforced concrete base slabs and wiring arrangements vary with location and purpose of unit.



Range light assembly, designed by Teterboro's Supervising Engineer Jack Echardt, combines standard AN-L-9 shallow base marker with plug-in receptacle for tip-over

cone. Combination allows maximum plane clearance during fair weather and provides maximum visibility when field and runway markers are snow covered.

Except where intervals are adjusted at intersections, contact lights are spaced on 200-foot centers along both sides of runways and the south side of taxiways. Lights have asymmetric beams, toed in towards paved strips. White light is emitted through clear lenses along the major portion of the runways although, for the final 1500 feet of each strip, the lenses are half yellow-filtered to inform pilots, in planes taking off, of their position in relation to the end of the runway. To protect lights from being struck and damaged by snow plows during winter months, threaded sockets are located in concrete base pads, between lights and runways, into which flags can be inserted. The flags, serving as light position indicators when snow covers the field, are removed during normal weather. Runway markers are lighted with 325 lumen, 6.6 amp., A-21 clear medium prefocus base lamps.

Taxiway lights (blue filtered and housing 1020 lumen lamps) are similar in design to contact runway units.

Green-filtered range lights, indicating extreme limits of runways, are also illuminated by 1020 lumen lamps but special assemblies were designed by Teterboro's supervising engineer, Jack Echardt, and Douglas Wolfe, assistant airport manager, to incorporate the

desirable features of both the shallow base markers and the formerly-installed tip-over cones. Concrete base pads are fitted with auxiliary plug receptacles that are located on the runway side of shallow base lights and are series connected. Concrete guards at either side of the receptacle prevent damage by field equipment. In fair weather, shallow base units furnish required illumination without interfering with landing gear of incoming planes. During winter months, tip-over cones, placed on the pads over the shallow units and plugged into the adjacent receptacles, raise range lights above snow levels. Base plug-in boxes are fitted with double spring series receptacles so that circuits remain unbroken when plugs are removed.

Runway and taxiway lights, series connected by trench-lay Number 8 RJ cable, are so circuited that the lights along either runway or taxistrips can be illuminated from a control tower switch panel. From this control board, an operator can control the two-stage selector switches which activate remote magnetic-contactor selector relays. When a remote relay is de-energized, the released contactor acts as a short across the ends of the affected circuits and, with current by-passing the circuit, lights remain inoperative.

Incoming service at 2400 volts is stepped up to 240/120 volts through a 7.5 kw. distribution transformer. Current passing through field lighting circuits is maintained at 6.6 amps. by a constant current regulator.

In installing circuits for runway, range and taxiway lighting, a maximum cable depth of 18 inches was established and all cable bends were made with radii of 36 or more inches. To allow for ground settlement, three feet of slack was left in cable runs at each side of units in addition to loops provided for connections.

To minimize hazards during plane landings and takeoffs, a continuous procedure was followed by which trenching, cable laying, backfilling and tamping became closely related operations. Trenching was performed by tractor-treaded rotary bucket machines, the removed earth being piled in a continuous ridge alongside the trench by means of the belt conveyor installed transversely beneath the upper travel of the buckets. As cable reels were unrolled and cables were placed in trenches, earth was pushed back into trenches by following bulldozers and the backfill was compacted into place by pneumatic tampers. With trenches open only during laying of cables, maximum safety was maintained.

Figuring Apartment Voltage Drop

Feeder drop considerations in New York's 2½ percent limit is also applicable to National Code jobs.

By C. A. Vanhorn
Marshall Electric Corp.
New York

ONE short sentence in the New York City Code has more effect on electrical installations—their adequacy and overall costs—than any other change in the code in many years. It is—"Mains and feeders shall be of such size that the voltage drop up to the final distribution point shall not exceed two and one-half percent."

A comparison of this provision with the National Electrical Code reveals a maximum limitation of two and one-half percent in New York City as against a recommended limitation of one percent contained in the National Code. However, custom prevailing under the National Code today, and in New York City prior to the present code, permitted up to five percent on lighting feeders; and it is with lighting feeders that the code limitation on voltage drop is applicable.

The net effect of establishing this change in New York City has been to increase the copper requirements one hundred percent with an attendant increase in conduit sizes.

The New York electrical contractor files with his application for inspection the following feeder data: "Area in square feet; load (before applying demand factors); required demand-factor computed load (after applying demand factors); and the size of conductors."

The City Code provision for calculating load on apartment feeders is identical with the National Code, viz.

two watts per sq. ft. of area, plus 1500 watts appliance load per apartment. The demand factors applicable are also identical.

The limitation of two and one-half percent maximum voltage drop for total lighting feeder drop from service point to the final distribution panel has long been recognized nationally by design engineers for industrial and commercial buildings and, for apartment installations. The usual practice is to allow one-half percent for main feeders, and two percent for sub-feeders.

While the normal apartment load on

ELECTRICAL FORMULAS

Following are formulas used to determine wire sizes, or voltage drop, for various types of electrical distribution systems in general use in New York City.

1. For a single-phase, two-wire, 120 volt system.

$$CM = \frac{10.8 \times 2 \times L \times I}{2\% \times 120}$$

CM = Circular Mil Area.
L = Single way distance.
I = Line Amps.

2. For a single-phase, three-wire, 120/208 volt system.

$$CM = \frac{10.8 \times 2 \times L \times I_{max.}}{2\% \times 120}$$

$I_{max.}$ = Current of heavier loaded phase wire.

Note: As $I_{max.}$ on balanced loads equals 50% of the demand load of two apartments grouped on the three-wire system, the copper used is 37.5%, or a net saving of 62.5%, as compared to the single-phase two-wire installation.

3. For three-phase, four-wire, 120/208 volt system.

$$CM = \frac{10.8 \times L \times I_{\phi}}{2\% \times 120}$$

I_{ϕ} = Maximum single phase load.

Note: The use of four wires to serve three apartments requires one third the copper, or a net saving of 66% as compared to the single-phase two-wire installation, as the copper size per apartment feeder is 50% of the latter installation.

Alternate three phase calculation:

$$CM = \frac{10.8 \times 1.73 \times L \times I_{3\phi}}{2\% \times 208}$$

$I_{3\phi}$ = 3-phase line amps.
 $P_{3\phi}$ = 3-phase power load.

$$\text{And, } I_{3\phi} = \frac{P_{3\phi}}{3 \times 120}$$

Neutral: In all cases the neutral is the same size as the phase legs.

As the circular mil area is proportional to the length of feeder and the current value, and inversely proportional to the voltage and the percent drop, existing handbook tables can be readily converted for use in making or checking the wire selection.

The designer or estimator can readily prepare his own chart to simplify the calculation data and wire selection for various unit areas. The use of a planimeter will facilitate accurate measurement of areas.

With such a chart it is possible to check and correct a riser diagram in fifteen minutes on a 150 unit apartment house after measuring areas and taking off the length of feeders.

measurement is found to be from 12 to 15 amperes, the demand load as calculated under the City and National Code ranges from 20 to 30 amperes depending on the apartment area.

In the past, partly due to the competitive field for this type of work, and partly due to economy in design, many installations carried No. 8 wire to the 20th floor apartment cut-out panel. Allowing 50 feet for the cellar run from the meter cutout to the riser, and ten feet per floor for the riser, this would total 250 feet. Now, under the new code requirements, an apart-

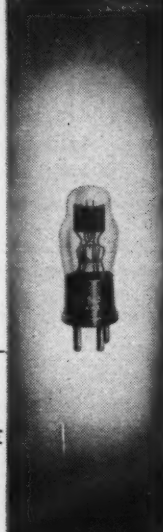
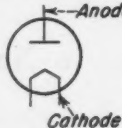
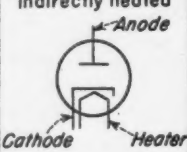
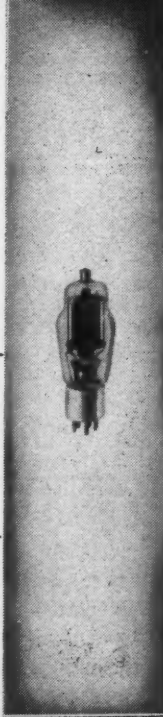
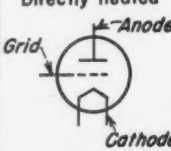
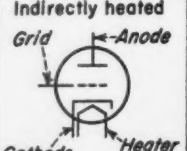
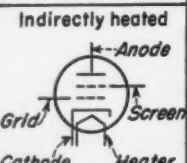
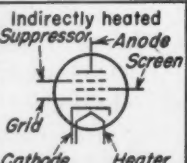
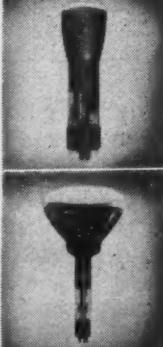
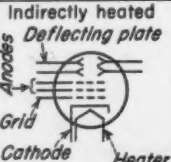
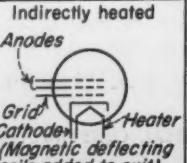
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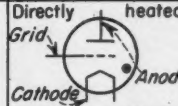




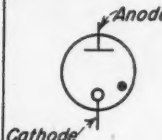



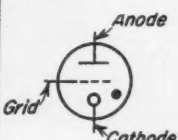

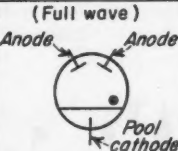



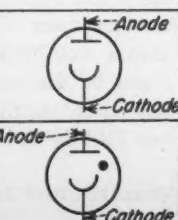

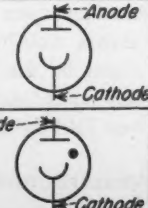
Industrial Electronic Components

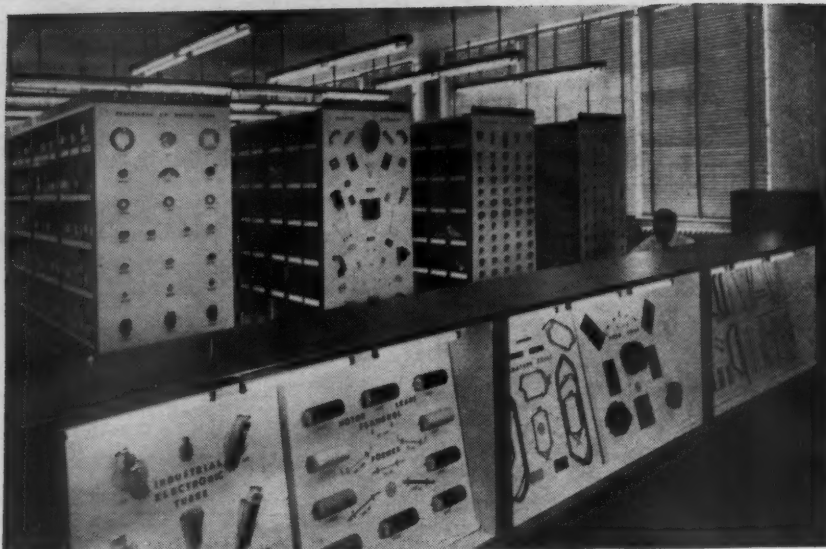
Pictorial index to useful data about electronic tubes and components used in industrial electronic applications.

By R. B. Immel
Westinghouse Electric Co.

CLASSIFICATION OF INDUSTRIAL ELECTRONICS APPARATUS

	TERMINOLOGY		TYPICAL DEVICES	SOURCE OF ELECTRONS	METHOD OF CONTROL	CHARACTER OF SPACE OR CONDUCTION MEDIUM	INDUSTRIAL	FUNCTION	TYPICAL APPLICATIONS			
	INDUSTRIAL	RADIO										
TUBES	KENOTRON	DIODE			NONE		Directly heated	RECTIFICATION	HIGH VOLTAGE-LOW CURRENT RECTIFICATION FOR:- RADIO RECEIVERS X-RAY TUBES ELECTROSTATIC PRECIPITATION VACUUM TUBE VOLTMETERS TELEVISION APPARATUS RADIO TRANSMITTERS			
												
		Indirectly heated										
		DUO-DIODE										
	PLIOTRON	TRIODE			ELECTROSTATIC	VACUUM	Directly heated	SWITCHING RECTIFICATION CONTROLLED RECTIFICATION AMPLIFICATION OSCILLATION INVERSION	OSCILLATORS AND AMPLIFIERS FOR RADIO RECEIVING AND TRANSMITTING APPARATUS HIGH FREQUENCY INDUCTION HEATING CARRIER CURRENT CONTROL FREQUENCY MULTIPLICATION AND DIVISION MISCELLANEOUS INDUSTRIAL CONTROL DIATHERMY			
												
		Indirectly heated										
		TETRODE										
		Indirectly heated										
		PENTODE										
		Indirectly heated										
		CATHODE RAY										ELECTRO-MAGNETIC
												
	Indirectly heated											

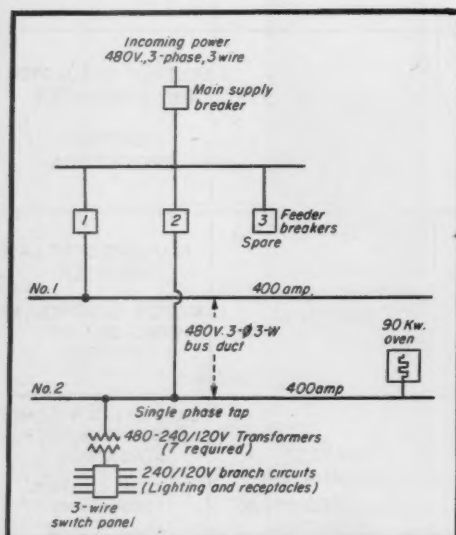
TERMINOLOGY		TYPICAL DEVICES	SOURCE OF ELECTRONS	METHOD OF CONTROL	CHARACTER OF SPACE OR CONDUCTION MEDIUM	INDUSTRIAL	FUNCTION	TYPICAL APPLICATIONS	
INDUSTRIAL	RADIO								
TUNGAR OR RECTIGON	HALF WAVE RECTIFIER		THERMIONIC CATHODE	NONE	GAS (HIGH PRESSURE)	<div>Directly heated </div>	RECTIFICATION AND SWITCHING	LOW VOLTAGE - HIGH CURRENT RECTIFICATION BATTERY CHARGING	
PHANOTRON	HALF WAVE RECTIFIER (MERCURY OR GAS)				GAS OR VAPOR (LOW PRESSURE)			RECTIFICATION OF MODERATE CURRENT VALUES UP TO 20,000 VOLTS (MERCURY VAPOR) FOR RADIO TRANSMITTERS AND INDUSTRIAL APPLICATIONS RELAXATION OSCILLATORS	
THYRATRON	GAS TRIODE			ELECTROSTATIC	GAS OR VAPOR	<div>Directly heated </div>	SWITCHING CONTROLLED RECTIFICATION	WELDING CONTROL VOLTAGE OR PHASE CONTROLLED RECTIFIER MOTOR SPEED CONTROL VOLTAGE REGULATION ELECTRONIC TIMERS	
	GAS TETRODE					<div>Indirectly heated </div>			
FLUORESCENT			COLD CATHODE	NONE	GAS	<div></div>	PRODUCTION OF LIGHT	INDUSTRIAL, PUBLIC AND HOME ILLUMINATION	
VOLTAGE STABILIZER GLOW-TUBE	NEON BULB OR VOLTAGE REGULATOR TUBE					<div></div>	VOLTAGE REGULATION	VOLTAGE REGULATOR AND STABILIZER CIRCUIT PROTECTION	
FLUORESCENT LAMP GLOW-TUBE STARTER				ELECTROSTATIC		<div></div>	TIME DELAY SWITCHING	FLUORESCENT LAMP STARTER MOTOR CONTROLLER TIME DELAY SWITCH	
GRID-GLOW						<div></div>	VOLTAGE REGULATION SUPER SENSITIVE DETECTION	CONTROLLED VOLTAGE REGULATOR AND STABILIZER REMOTE CONTROL SWITCHING INSULATION CHANGE DETECTION	
PPOOL TUBE	MERCURY ARC RECTIFIER		MERCURY POOL CATHODE	NONE	MERCURY VAPOR	<div>(Full wave) </div>	RECTIFICATION	HIGH VOLTAGE, HIGH CURRENT RECTIFIER POWER FOR ALUMINUM, MAGNESIUM, MINING, ELECTROCHEMISTRY, TRANSPORTATION AND STEEL INDUSTRIES	
IGNITRON (SEALED TYPE)				IGNITION ELECTRODE		<div></div>	RECTIFICATION CONTROLLED RECTIFICATION SWITCHING	SPOT WELDING CONTROL HIGH VOLTAGE, HIGH CURRENT RECTIFICATION DC TO AC INVERSION SWITCHING	
IGNITRON (PUMPED TYPE)						<div></div>		POWER FOR ALUMINUM, MAGNESIUM, MINING, ELECTROCHEMISTRY, TRANSPORTATION AND STEEL INDUSTRIES	
PHOTO-TUBE			PHOTOELECTRIC CATHODE	LIGHT OR RADIANT ENERGY	VACUUM GAS	<div></div>	LIGHT DETECTION LIGHT MEASUREMENT	SOUND MOVIES LIGHT AND-COLOR MEASUREMENT PICTURE TRANSMISSION PROCESS AND QUALITY CONTROL APPARATUS DETECTION DEVICES TINPLATE PINHOLE DETECTOR CUTTING, WINDING, AND PRINTING CONTROL	



The Renewal Parts Center, first of its kind for G.E.'s Apparatus Department, features over-the-counter service on some 2300 different industrial parts for G-E equipment.



No. 2 busduct feeder required special offset fitting to miss crane rail. Electrical contractor made this fitting.



Electrical distribution system which furnishes adequate power and provides distribution flexibility throughout.



Exterior view of General Electric Service Shop and Warehouse building, Baltimore. Building houses The Renewal Parts Center, repair shop and warehouse, and general office areas.

By
Berlon C. Cooper

Wiring a Service and

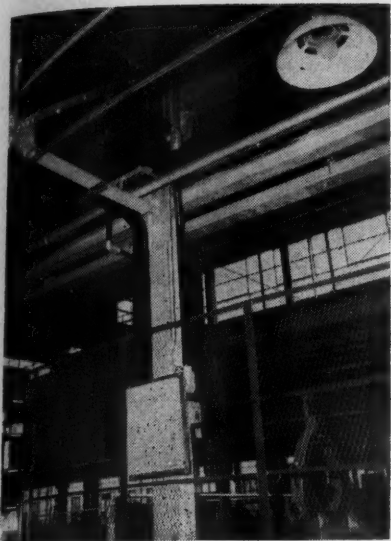
ADEQUATE electric power is available when needed, in General Electric's new service shop and renewal parts center, Baltimore. It is available from the 480-volt, 3-phase, 3-wire electrical distribution system used to supply power throughout its 28,000 sq. ft. repair shop area, 14,000 sq. ft. warehouse area, large renewal parts center, and general office areas.

The 480-volt switchgear is of the drawout type with air circuit breakers,

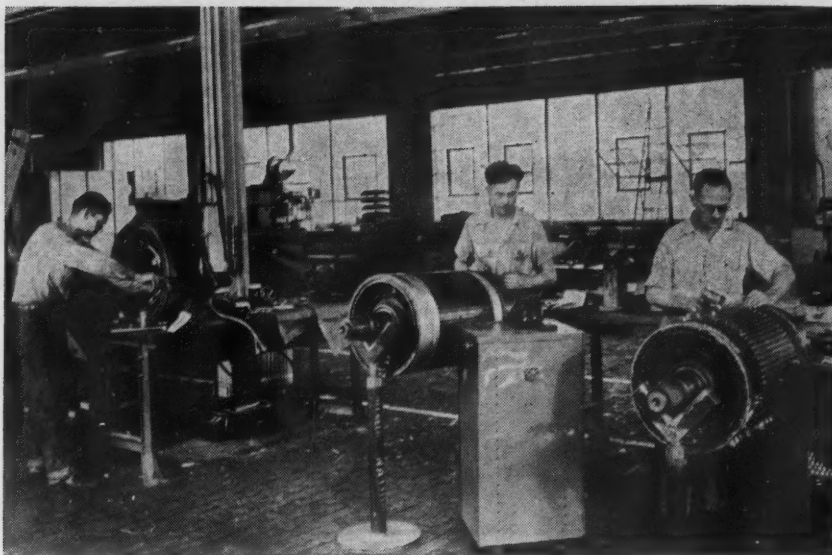
consisting of a main breaker, a feeder breaker for each of the flexipower buses, and a spare breaker for future feeders. One busduct (No. 1) is installed overhead on the low bay area on the same side with the incoming power switchgear panels. The other busduct (No. 2) is carried overhead across the high bay crane area and down to the ceiling level of the low bay area on the opposite side. This bus duct is then installed on the steel

columns below the crane rail, where power can be furnished to machines in the high bay area and to the warehouse area, adjoining.

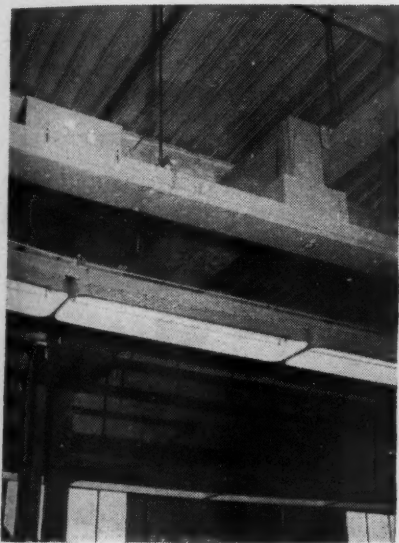
Seven dry type transformers of the 15, 25 and 37.5 kva. sizes as required, are located at load centers to supply 240/120 volt single-phase three-wire power for lighting loads and convenience receptacles throughout the building. Branch circuit switch panels are located on columns below the trans-



Dry type transformers of the 240/120 volt single phase type are located at load centers.



Typical view in repair shop. Power furnished is adequate for all repair and test work. Continuous row Miller 3/40 watt fluorescent reflectors light this area to a maintained average of more than 60 foot candles.



Busduct feeders Nos. 1 and 2 rise to ceiling from switchgear located at wall near primary service poles outside.



High bay crane area divides machine shop area on right from warehouse area on left. Busduct is located on steel columns at left, below the crane rail. Miller 2/100 watt fluorescent fixtures light the high bay area.

Repair Shop

Adequacy and flexibility in electrical distribution system are featured in new service and repair shop for electrical apparatus.

formers, and control the branch lighting and convenience receptacle circuits, in the repair shop area as well as in the renewal parts store and office areas.

A 90 kw. electric oven, ten feet high and fifteen feet square, located at one end of the crane area, is fed directly from the No. 2 400 amp. busduct.

Trolley duct was installed throughout the warehouse area, over the aisles between the stock bins. Glassteel dif-

fusers of the 300 watt size are installed on the trolley duct, so that units may be quickly moved to provide maximum light where needed.

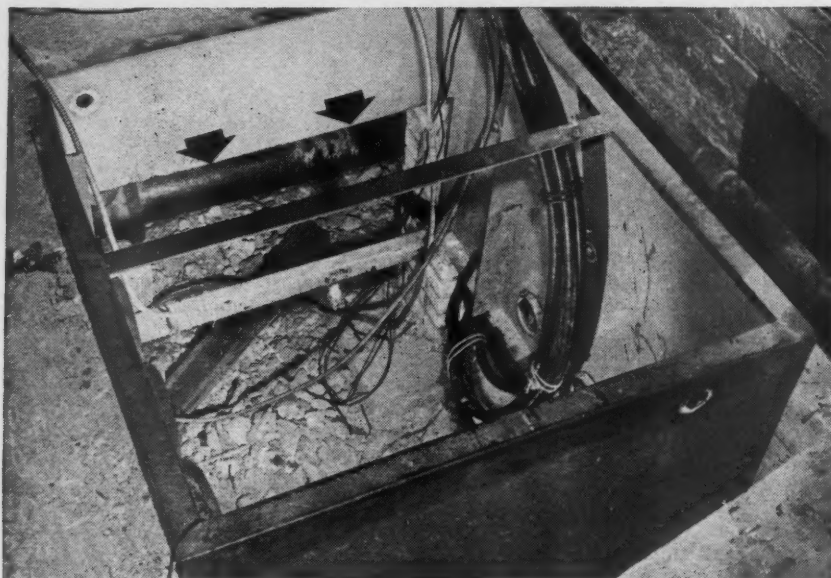
Average demand for power is 90 kw. for the oven, 100 kw. for lighting, and 50 to 150 kw. for power. The two busducts, each of 400 amp. capacity, more than take care of all present load requirements. The spare breaker at switchboard is also available for a future 400 amp. feeder, if required. Use

of busduct also assures maximum flexibility in locating new machines, or relocating machines to meet any production line requirements. Thus adequate power is provided for full service on all types of electrical apparatus.

Egli and Gomph, consulting engineers in Baltimore, planned the electrical installation in cooperation with A. G. Hoyt, superintendent of the shop. Brown & Heim, electrical contractors, installed all the electrical work.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods



Under-floor splice cabinet with top, bottom and side covers removed. After splices are made, access will be through side opening (arrows) adjacent to pipe tunnel. Bottom can also be removed.

Under-Floor Splice Cabinet

WIRING

An under-floor splice cabinet solved a space problem for the Langford Electric Company, Minneapolis electrical contractors doing a local hotel rewiring project.

Feeder cables for all risers going up the elevator shafts came underground in fibre ducts from the main distribution board to a point adjacent to the bottom of the shafts. Here the lead-covered cables were to be spliced to the rubber-covered risers.

To accommodate the splices, Langford designed a 4-ft. by 4-ft. by 3-ft. deep steel box and buried it in the ground a few inches below finished floor level. This steel shell, resting on short brick columns (28-inch clearance between bottom of box and pit floor) was designed with a removable top, bottom and one side. The removable side provides access from an adjacent pipe tunnel.

After the splices are made the bottom, top and side covers are mounted in place. To take advantage of the 16 sq. ft. of floor area occupied by

the cabinet, the finished floor will be poured over the top cover. Thereafter, access will be through the side and/or bottom covers. Should serious repairs require more working space, the thin concrete on top of the box can be removed and the top cover opened.

Shop-Made Racks For Wire Reels

INDUSTRIAL

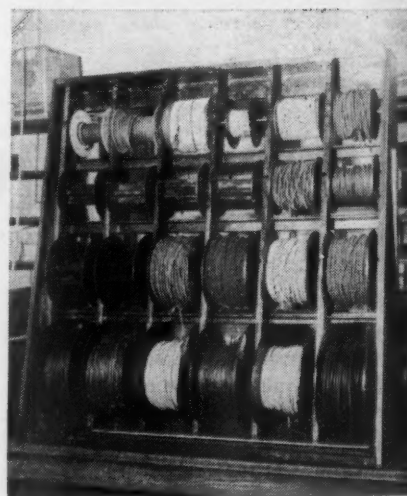
The Buchanan Electric Company stocks wire of various sizes in two useful coil racks which were designed and constructed in the company's Campbellsville, Kentucky, shop. Available material was ingeniously used with a minimum of purchased lumber, plywood and hardware, resulting in a total material cost below \$55 for both racks. The available material included such diverse items as a wooden porch column, several discarded automobile brake rods and sections of water pipe.

The rack for stocking heavy wire

consists of seven reels mounted in a supporting wooden cradle. Reels revolve on horizontal shafts, permitting the rapid removal of wire without kinking or twisting. When not in use, cable ends are tucked neatly into holes bored through frame braces and rotation of the reels is prevented by inserting wedges between spools and frame. Mounted on heavy industrial castors, the frame and reels may be moved freely and easily although the loaded weight is between six and seven hundred pounds. The overall dimensions of the rack are 12 feet in length, 14 inches in width and 24 inches in height from floor level to top of spools.



Castor-mounted cradle contains seven reels for stocking large-sized cable. Assembly can be moved about shop readily. When not in use, cable ends are tucked neatly into holes bored in frame cross-braces. Rotation is prevented by inserting wedges between frame and spools.



Counter-placed rack holds two dozen reels of varying diameters for stocking small size wire used most commonly by Buchanan Electric Company, Campbellsville, Kentucky.

Reel side-discs, 16 inches in diameter, are of 5/6-inch plywood. Center reel cores (6-inch diameters) are 8 inches in length. Reel discs are held firmly to the cores by means of nuts tightened over the threaded ends of brake rods running in contact with and parallel to the cores. Axles, of 1/4-inch bar stock, fit into frame notches spaced on 18-inch centers and can be lifted from these notches should it be desired to remove a reel from its cradle. Axles pass through 1/2-inch pipe sleeves which are driven through the center of reel cores. The framework, of 1-inch poplar, is reinforced by sturdy intermediate cross members bolted at all intersections. Each reel, when the full capacity is utilized, can hold either 150 feet of 6/3 wire, 200 feet of 8/2 entrance cable, 1000 feet of number 6 solid copper or stranded ground wire, or 500 feet of either

number 4 or 6 rubber covered conduit wire. These sizes are used most frequently by the Buchanan Company for residential, farm and commercial wiring in the Campbellsville area.

A useful rack for holding smaller sizes of wire covers a counter area 17 by 47 inches and measures 4 feet in height. Two dozen reels are independently mounted and may be removed readily for replenishing from manufacturers' coils. From the top to the bottom of the rack, six coils in each row have diameters of 6.5, 7, 10 and 13 inches. Depending upon this varying reel size and the type of wire stocked, from 250 to 1000 feet can be stored on each spool. The wire commonly stocked on this rack includes rubber covered or twisted rayon wire for small-capacity circuits, aeri-als, bells, appliance and lamp extensions.

volt main distribution panel. The existing panel contained two 1,200-ampere, 4-pole, two-phase, air circuit breakers which were split to form the new unit.

Sweningson engineer W. L. Carlson merely disengaged one pole of the second 4-pole breaker and added it to the adjacent unit by means of a mechanical tie-bar. Necessary busbar rearrangement accompanied the shift to enable 5-pole breaker to serve the panel. The existing 3-pole main breaker will remain as a spare to be utilized when the plant changeover to three-phase distribution is completed. A new group of 5-pole, fused, knife switches serve the secondary feeders to the various plant buildings fed from this specific transformer vault.



Closeup of the two 1,200-ampere, 480-volt air circuit breakers that were revamped to form one 5-pole and one 3-pole unit. Arrow shows where the fourth pole of one breaker was disengaged and tied to the second unit at right. Three-pole breaker remains as a spare for future 3-phase use.

Trough Feeder From Stairwell

—WIRING

Feeding distribution panels from stairwell conduit risers frequently presents an installation problem, particularly where minimum headroom requirements must be met. Such a condition was encountered by the Continental Electrical Construction Company, Chicago electrical contractors and engineers, during a changeover from direct current to alternating current service in a local commercial building.

Long wiring troughs and pull boxes were utilized wherever possible to facilitate cable installation between the different elevations encountered; stay within the headroom limitations; and still make a trim job. Among the more elaborate troughs designed is that illustrated on the next page.

Here the distribution panel is located between the fourth and fifth floors, some eight feet from the stairwell partition. Conduit risers are in the stairwell, 13 ft., 9 in. away. Difference in elevation between the fourth floor ceiling and under side of the adjacent stair landing is 42 inches. To get the feeder cables from the riser conduits to the panel, L. W. Witz, Continental engineer, designed and installed a triple-offset cable trough with conduit entrance header.

Ceiling and wall mounting are provided by angle-iron brackets welded to the trough sides. The conduit entrance header is supported by suspension rods fastened to the underside of the steel stair framework. At the panel terminal, the trough drops down some 49 1/2 inches to the top of the panel "tub."

Five-Pole Breaker Made From Two Units

—WIRING

Inability to get delivery on new circuit breakers did not prevent Sweningson & Company, Chicago electrical contractors and engineers, from energizing the "Carlson System" of dual phase distribution being installed at Sherwin-Williams Company's Chicago plant (E. C., Dec., 1946, pg. 51). Sweningson simply revamped exist-

ing equipment to meet the new requirements.

The "Carlson System" of 5-wire, combined 2-phase and 3-phase distribution involves the addition of a third transformer to the present two-phase bank to provide the three-phase energy source. This requires a 5-pole incoming circuit breaker on the 480-

Two Great Plants - To Serve You Better



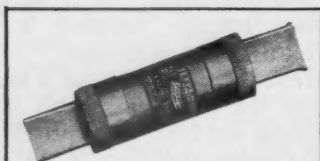
The Bellwood, Illinois, main plant and offices—over 250,000 sq. ft. of manufacturing floor space.



Jefferson Power Circuit Transformers are air cooled and can be mounted at any point where 115 volt current is required.



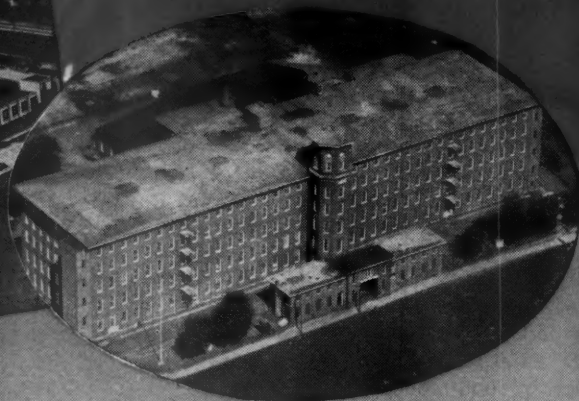
Jefferson Fluorescent Lamp Ballasts are famous for uniform quality, quiet operation and long life performance; for use with all commonly used lamps including cold-cathode lighting.



Jefferson Fuses are made for every service in both renewable and non-renewable types. They provide maximum protection with long-life dependability and safety.



The newly added Fall River, Mass., factory—250,000 sq. ft. of manufacturing space.

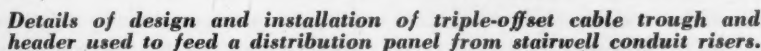


During more than 30 years of unsurpassed performance, users of Jefferson Electric Transformers have come to place complete reliance in their fitness for each particular application.

The Fall River plant addition—put in operation in late '46—insures still greater output. This with the greater use of latest types of machinery and equipment and control of materials and manufacture of all parts to final assembly assure the uniformity of quality on a quantity basis that has always distinguished Jefferson Electric products.

Expanding output, with a greater supply of vital raw materials will make it possible to meet your requirements better than ever before. JEFFERSON ELECTRIC COMPANY, Bellwood (Chicago Suburb), Illinois. In Canada: Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ont.

TRANSFORMERS



Trough cable are supported by inverted-U, snap-in steel brackets

equipped with an ebony-asbestos shelf on which cables rest. After the top tier of conductors have been laid in the trough, they are pushed up in place by the brackets which are then twisted slightly (to be at right angles to the trough length) and snapped into position. Brackets rest on the bottom flanges of the trough (at cover openings). Shorter brackets (height) are used for lower tiers of cables. Details of installation are shown above.

Outdoor Trough For Branch Circuits

Swenningson & Company, Chicago electrical contractors and engineers, carry this practice one step further. They install the branch circuit conductors in a weatherproof trough extending up the side of the building. The galvanized sheet steel trough is designed to accommodate the required number of branch circuit conductors

Branch circuit conduits enter the back of the trough and extend inside the building in the concrete floor slab to equipment locations where they are turned up well above finished floor level. An explosion-proof sealing fitting is inserted between the conduit stub and the motor control unit. Particular care is exercised that no couplings are in the conduit stub between the sealing fitting and the floor slab.

Because there are solid conduit runs

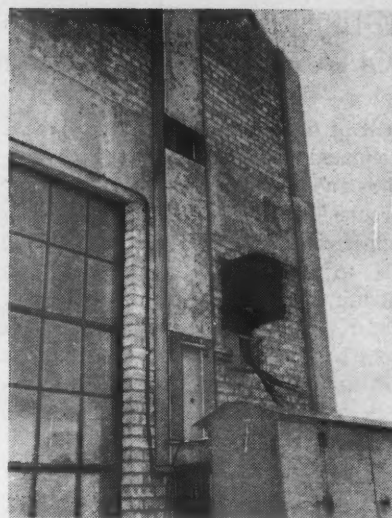
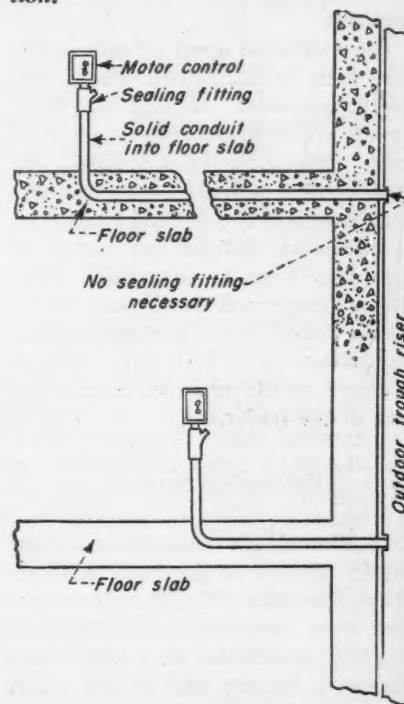


FIG. 1—With solid conduit stub extending from control sealing fitting into floor slab, no sealing fitting is necessary at outdoor trough termination.



Divided trough riser on building exterior carries power and lighting branch circuits from outdoor distribution cabinet to explosion-proof control units inside building. Branch circuit conduits in floor slabs enter back and bottom of trough.

Greatest advantages of this scheme—designed for a Sherwin-Williams Company plant installation in Chicago—are: (1) Elimination of one explosion-proof sealing unit on each branch circuit conduit and (2) conductor installation and replacement ease.

FIGURING APARTMENT VOLTAGE DROP [FROM PAGE 67]

ment of 650 sq. ft. area would have a calculated demand load of 23.3 amperes and would require a No. 4 feeder for the same run. The increase in copper circular mil area is from 16,500 CM to 41,700 CM; an increase in conduit for a three-phase four wire feeder serving three apartments is from 1 in. to 1½ in. Few installations will now permit No. 8 as a feeder as high as the 8th floor on tenant metered installations.

In addition to increasing the copper wire and conduit sizes on the sub-feeders, the main feeders and the service and distribution equipment are also increased, and material and overall labor installation costs are directly increased as a result of this voltage drop rule.

The individual areas of each apartment must be calculated from the outside dimensions. As the apartment layouts are often irregular, a series of room units must be calculated and totalled; then individual apartment unit total loads and net demand loads must be calculated, and the line current to each apartment is computed. Then having determined the distance to the cut-out panel from the meter cut-out, the voltage drop formula is applied to determine the minimum circular mil area of the feeder.

Economical Network

In New York City the electrical supply network is generally a three-phase four-wire 120/208 volt system. The most economical installation is to group apartments on a three-phase four-wire feeder; and as the utility company requires that all meters be placed in the basement meter room, a four-wire feeder may be run for each group of three apartments. On tenant metered installations for a 100-family house, a minimum of 34 feeders of four wires must be carried up from the basement meter room for serving the individual apartment units only.

For buildings having master metering a four-wire riser can serve all apartments on the riser clear to the top floor. By grouping the areas of all apartments served by a single three-phase four-wire feeder and applying the increased demand factors permitted by the code a great saving is made on wire and conduit, which when added to the elimination of individual meter-

ing equipment makes for the most economical electrical installation. The loaning institutions, however, generally insist that the installations be tenant metered; or in the event that master metering is installed, they sometimes prefer individual tenant feeders so that tenant metering can be easily installed if desired at a later date.

Likewise, for buildings requiring individual tenant metering the most economical installation as pointed out above is to group three vertically adjacent apartments on a three-phase four-wire feeder. The area served by the feeder is the total area of all three apartments. The line current of the feeder is the resulting three-phase current after applying the demand factor permitted. Inasmuch as the three areas may be somewhat different, and the top apartment is 20 feet further from the meter bank than the lower apartment, it is preferable to take the maximum single phase calculated load by the product of the distance—in short the maximum amp-feet product. Theoretically the selection of the three-phase ampere load multiplied by the factor 1.732 in the three-phase formula gives the same result as the use of the single phase load. Actual calculations grouping the three areas and applying the demand factors gives a slightly different result. The technically correct procedure to insure compliance with the code is to assume balanced loading and select the maximum amp-feet product, using the single phase loads.

The most practical method to reduce calculation time would be to select the maximum single-phase load and the maximum distance. In practically all cases the wire size so determined will be the same regardless of method used for calculation, because of wide spread between circular mil areas of consecutive trade sizes of wire.

There is considerable confusion as to the correct method of calculating the voltage drop on a three-phase four-wire feeder for this type of installation. Most handbooks with amp-ft. tables utilize the one way distance, but their calculation is generally based on a single-phase load and the two way distance and result in a selection of wire having double the circular mil area required, for a three-phase four-wire feeder.

It is maintained by some engineers that inasmuch as two tenants may be away for extended periods, that the calculations must be treated as a single-phase two-wire feeder. This

basis of calculation would double the size of copper permitted by the code, and in effect quadruple the size of copper installed as compared to prewar installations.

The codes do not require this as a basis of calculation. The code permits the grouping of three single-phase loads with a common neutral on a three-phase four-wire feeder. Thus the feeder for all purposes of the code can be treated as a group feeder.

Feeders

It is interesting to note that when proper consideration is given to voltage drop, the feeder sizes as determined favor the use of Type R wire as against Type RH insofar as costs are compared. The minimum size feeder calculated for recent apartment installations in New York City was No. 10. In all cases the apartment demand load was under 33 amperes—and with few exceptions was under 30 amperes. The voltage drop fixed the copper wire size regardless of type of installation to be used. In all cases the safe current carrying capacity of the required wire size was greater than the load. No saving in conduit can be effected by the use of Type RH to offset the increased cost of Type RH wire. However, on combination power and lighting feeders to machinery rooms on the top of the building savings can frequently be made by the use of Type RH or Type V wire.

At present Marshall Electric Corporation has two apartment projects under construction for which approval has been obtained from the respective code authorities on wire selections made. These projects are 15 and 19 story and penthouse apartment buildings, one having 100 units, and the other 175 units. Design calculations made to comply with the code vary considerably from the original riser plans submitted for bid purposes. On one project it was possible to reduce feeder costs to the builder by approximately 50 percent; on the other project it was necessary to increase the size of feeders resulting in increased feeder costs of approximately 40 percent.

On several other jobs where no layout was given for the apartment feeders, it was found that the margin of difference in bids was substantially the increased cost of feeders under the new code requirements, leading to the belief that the new problems under the revised code are not yet stabilized in the industry.

LOUVERALL CEILING

[FROM PAGE 59]

for the 100-watt T-17 and the 96-inch Slimline lamp. If lamps are arranged in groupings, the distance between groups can be greater than equally spaced single-lamp rows. However, the louver brightness will be less uniform and the choice of arrangement becomes one of appearance rather than light utilization.

If essentially uniform louver brightness is desired between rows of lamps, the louver should be suspended below the lamp a distance equal to or greater than about two-thirds the spacing between rows. This relationship follows the old rule of thumb for luminous architectural elements, which allows a spacing between lamps of one and one-half times the distance to the diffusing translucent surface for uniform brightness. Table 3 indicates these lamp-to-louver distances for the conditions given in Table 2. The louver brightness gradient between rows of lamps is more gradual and even with small cells than with large ones.

As previously mentioned, the ceiling finish has an important effect on the utilization of louverall installations. White ceilings are better than black ones on three counts: (1) system efficiency, (2) more uniform louver brightness, and (3) more favorable contrast conditions when the lamps are (a) mirrored in polished surfaces or (b) seen if one happens to look directly up at the ceiling. Reflectors can be used around the lamps if there is no flat ceiling above or if particular conditions make it easier to maintain the system by periodic cleaning of the reflectors rather than the ceiling. Non-uniformity of louver brightness may be objectional, however, even though the efficiency is higher because more light comes directly through the louver openings.

Standard sections of louverall are now being designed by several manufacturers. One company has listed a unit almost eight feet square, with the louvers in four sections and using 12, 22 or 42 40-watt fluorescent lamps above 2½ by 2½ by 2-inch cells. In a room of moderate dimensions, these are said to produce approximately 50, 100 or 200 footcandles, depending on the number of lamps employed. Such a unit could be installed flush.

Louverall lighting is unobtrusive in appearance and has a versatility which appeals to architects and electrical contractors alike.

CRESCENT

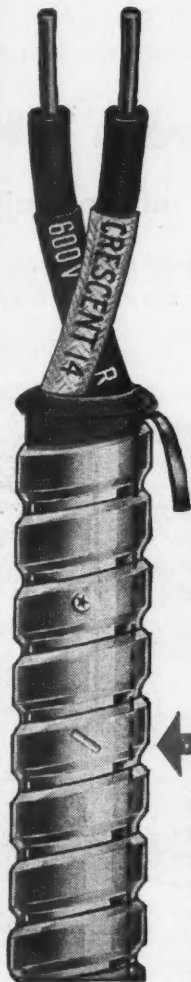
A B C Armored Cable

*Has These Improved
Features Which Result in*

INCREASED SAFETY

and

LOWER COST



Bond Strip Under Armor

← **Permanently low armor resistance is provided in sizes No. 14 and 12 AWG by use of a flattened bonding wire which is in contact with the under side of each convolution. These sizes now are smaller and lighter, since they use the smaller diameter Type R conductors of the 1947 National Electrical Code.**

Prefabricated Break Lines

← **The Cut Mark (at 1½" intervals) shows the location of a prefabricated breaking line inside the armor. Only a few strokes of a file guided by the Cut Mark are required to cut through one outer ridge, and a bend by hand severs the armor. This results in a clean separation with no sharp edge — a safer, easier and faster job. The prefabricated breaking lines are so designed that there is no reduction in tensile strength, bending quality, crushing resistance and electrical conductivity of armor.**

The Armored Cable Industry is celebrating its 50th Anniversary. In the last 20 years alone over SIX BILLION FEET of Armored Cable have been installed



**CRESCENT
WIRE and CABLE**



CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, N. J.



From 1/4 H.P. to 100 H.P.
dependable motor control by
FEDERAL NOARK

Where performance counts, count on Federal NOARK Motor Starters to keep production right on schedule — without delays resulting from control failure or unnecessary stoppage for maintenance.

All Federal NOARK Magnetic Motor Starters include manual or automatic reset overload relays... a feature found on no other motor starter.

Plan now to control your vital power circuits with always dependable Federal NOARK Motor Starters.

Mounting dimensions conform to new NEMA standards.

Federal NOARK
INDUSTRIAL CONTROLS

Executive Offices: 50 Paris Street, Newark 5, N. J.
Plants { Hartford, Conn. • Newark, N. J.
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Federal Electric Products Company, Manufacturers of a Complete Line of Electrical Products including:
Motor Controls • Safety Switches • Service Equipment • Circuit Breakers • Panelboards • Bus Duct

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of **ELECTRICAL CONSTRUCTION** and **MAINTENANCE** you saw the item and they will send full details to you.

Equipment News

Reflector

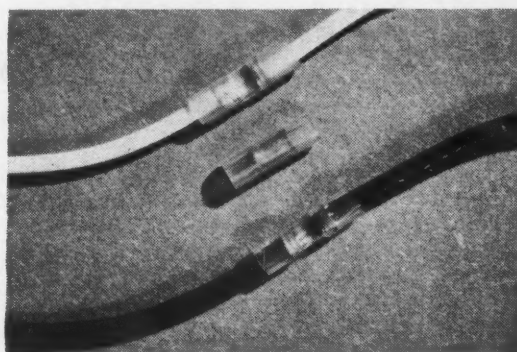
A further improvement of the Diskonect reflector has been announced. Designed for instant attachment or removal to simplify the job of cleaning, unit is now equipped with a spring lock that requires only thumb pressure to release it. Releasing is accomplished by a squeezing action at the neck of the reflector with thumb on the latch. Reflector, socket and lamp are removed as a unit. Quick disassembly of all parts is by a spring-mounted socket, which is removed by slight upward pressure and a quarter turn. Lamp and socket may be removed together. This complete "come-apart" construction permits cleaning of all parts separately. Finished in permanent porcelain enamel, the Diskonect is available in a wide variety of styles and sizes. It has a universal terminal base to fit both medium and Mogul sockets. Reflectors are interchangeable with three styles of hoods for pendant, right angle or ceiling mounting. Goodrich Electric Company, 4600 Belle Plaine Avenue, Chicago 41, Ill.



GOODRICH REFLECTOR

Pressure Connector

The No. 25 insulated splice has been added to this line of Sta-Kon pressure connectors. It is a seamless bronze connector protected with a translucent high dielectric plastic insulator that is impervious to oil, grease, water, chemicals and acids. The insulator is bonded to the connector and cannot slip or become detached. A single squeeze of the installing tool permanently connects both wires and insulates the connection. Available with the following wire capacities: 1-No. 14 and 1-No. 20; 2-No. 16; 1-No. 16 and 1-No. 18; 1-No. 16 and 1-No. 20; 2-No. 18; and 1-No. 18 and 1-No. 20. Thomas & Betts Company, Inc., 36 Butler Street, Elizabeth 1, N. J.



THOMAS & BETTS CONNECTOR

Circuit Breaker

The new Quicklag circuit breakers provide several new improvements such as a tripping action which combines the inverse time limit characteristics of Bimetal thermal action on overloads with the operating speed of magnetic trip action on short circuits. Available in single or double pole, 16 to 50 amperes, 125 to 125/250 volts a-c, a redesigned "De-ion" arc chute permits mounting flush to pan. Other improvements include a sturdier operating handle; internal design requires less handle movement; hole in handle permits more satisfactory method of attaching handle extension for two-pole operation; and smooth flush surface to eliminate dust traps. Westinghouse Electric Corporation, Pittsburgh 30, Pa.



WESTINGHOUSE CIRCUIT BREAKER

Electronic Control Unit Panel

Of heavy duty construction especially adaptable to steel mill, rubber mill, printing plant and similar applications, this quick change electronic control unit panel has been designed for rapid and easy servicing. The captive wing nut mounting and multiple contact plug arrangement permits instant substitution of a "spare" panel at any time to provide uninterrupted machine operation whenever emergencies may arise that require removal of the electronic unit for testing or service bench attention. Cutler-Hammer, Inc., 228 North 12th Street, Milwaukee 1, Wis.

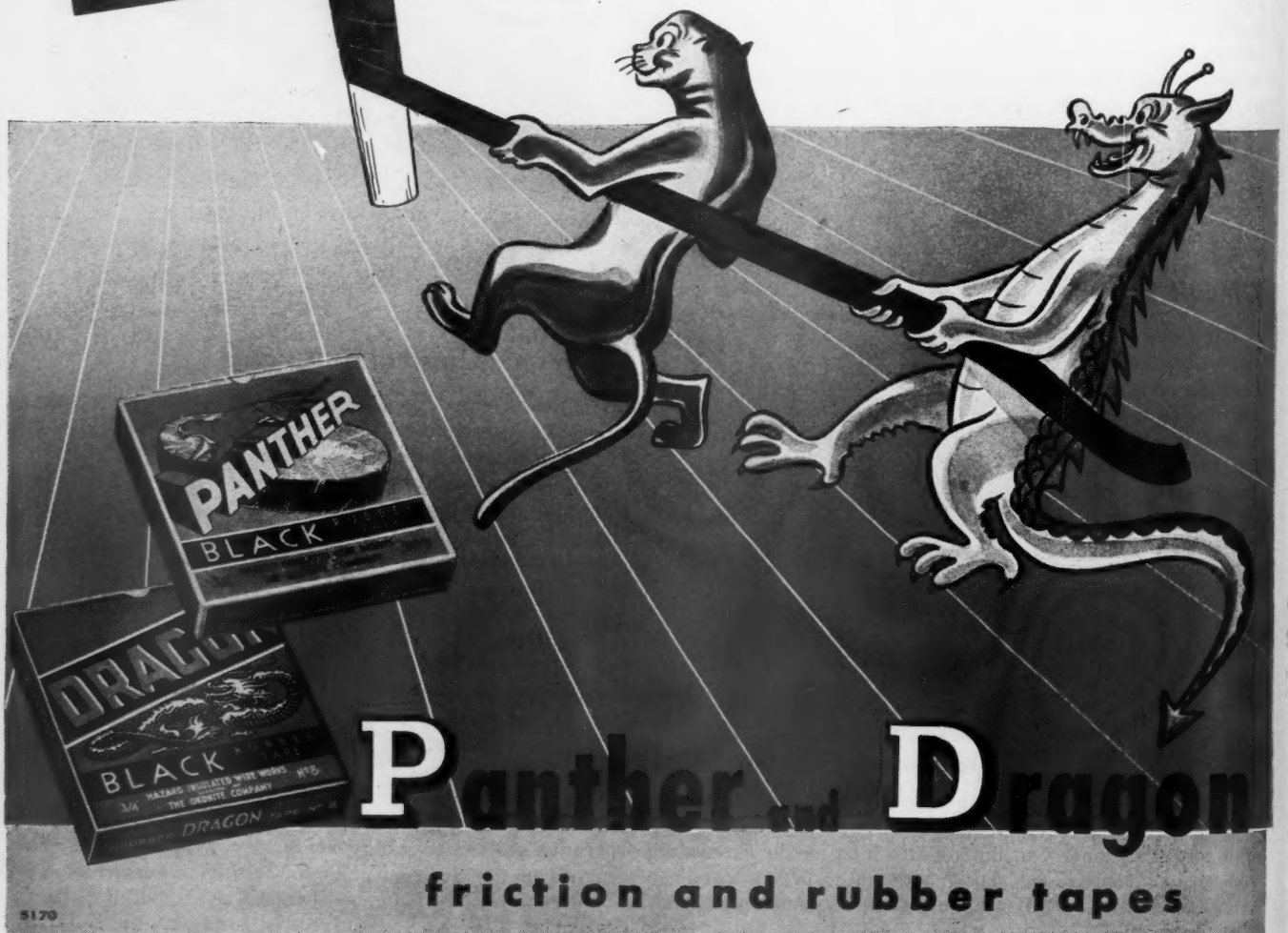


CUTLER-HAMMER CONTROL

TAPES THAT ARE TOPS IN



In all four of these major properties, PANTHER and DRAGON Rubber Tapes pass A.S.T.M. and other government specification tests with generous margins of safety. And they produce the kind of splices that are expected of such high-rated tapes. PANTHER and DRAGON Rubber Tapes assure safe electrical splices. Successive layers of tape readily fuse into one. Their tensile strength and "stretch-ability" make them unfailingly easy to work with. Manufactured by a company that has specialized in electrical insulation for nearly 70 years, PANTHER and DRAGON Friction and Rubber Tapes are sold only through recognized independent wholesalers. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.



Panther and **D**ragon

friction and rubber tapes

A-C Load Visualizer

The new AF-1 a-c load visualizer, for use on single-phase and balanced polyphase systems, has been announced. Besides serving as a standard 0-2.5/5 amp. ammeter and a 0-150/300/600 volt voltmeter, this instrument can be used with the calculator furnished to determine watts, vars, volt amperes, and power factor for load surveys, induction motor tests, reactive power studies and power factor checks on power and lighting circuits. The

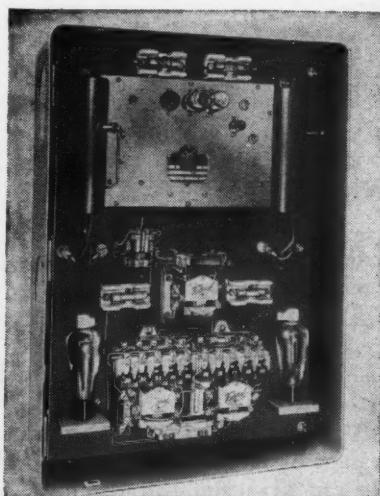
load visualizer has an iron-vane moving element and separate field winding for voltage and current. The current winding is electrically insulated from the imposed voltage by an internal double current transformer. The current and voltage terminals of the AF-1 are energized simultaneously from the line or through instrument transformers to extend the range. General Electric Company, Schenectady 5, N. Y.



G-E VISUALIZER

Electronic Motor Control

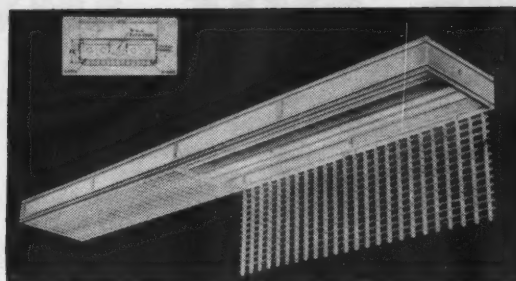
Two models of a new electronic motor control for operating d-c motors from a-c power have been announced. One model is a general purpose, reversing type applied to a 2 hp., 230 volt d-c motor, and the other a special control for an abrasive M-3 surface grinder. They can regulate motor speed to provide an almost flat speed torque curve with changes in load having little effect on speed. Automatic current limiting makes it possible to preset the maximum allowable armature current. The electronic circuits limit the current to the preset value regardless of load. Federal Electric Products Co., Inc., 50 Paris Street, Newark 5, N. J.



FEDERAL CONTROL

Fluorescent Fixture

A new Linolite slimline series has been added to this line of fluorescent fixtures. The new units are finished



FRINK LINOLITE

in white enamel baked at 350° F. They are furnished with two lamp ballasts which provide instant start 200 milliamp. operation to produce maximum low brightness light output. Available for either two or four lamps, they can be mounted as individual units or connected to form continuous runs. Two hinged louvre frames with specially designed latches for easy opening or removal provide illumination with 45 degree crosswise and 30 degree lengthwise shielding. The two lamp unit is 4½ in. deep, 11½ in. wide and 97 in. long. The four lamp is 4½ in. deep, 15½ in. wide and 97 in. long. Matching spot and downlights are available for combination and accent lighting. The Frink Corporation, 27-01 Bridge Plaza North, Long Island City 1, N. Y.

Switch

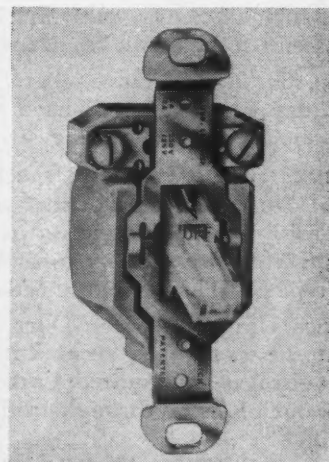
A single pole switch, Cat. No. 61, and a three-way switch, Cat. No. 63, designed particularly for residential applications have been announced. They meet Federal and REA specifications. Compact design together with large well recessed terminal screws assure easy wiring and quick installation. Washer type plaster ear yoke is insulated from the mechanism. These switches are "T" rated at 10 amperes 125 volts, 5 amperes, 250 volts and carry Underwriters' Laboratories' approval. Available with either brown or ivory handles. The Bryant Electric Company, Bridgeport 2, Conn.



Electric Wall Switch

A new type of electric light wall switch, equipped with a neon light in the switch handle has been announced. It is so designed that when the overhead lights are turned on the switch handle light is out, but when the overhead lights are turned off the switch handle glows with a soft light. The switch is the single pole type and will fit any standard receptacle. The switch handle, which is available in a variety of colors to fit the color scheme of the room, is easily renewed.

A safety feature guards against shock when changing the switch handle. Roberts Glo-Switch Div., 700 Jamaica Avenue, Brooklyn 8, N. Y.



ROBERTS GLO-SWITCH

This "slot" always pays off



MEMO TO CONTRACTORS

Here's an industrial magazine advertisement currently appearing in 15 publications to help you sell your customers an improved power distribution system.

DESIGNERS can lay out electrical systems with what seems to be ample allowance for future needs.

But they aren't fortune tellers. They can't foresee that some day a machine will have to be moved, an entire line relocated, or a lighting set-up shifted.

That's why it's wise to specify BullDog Universal Trol-E-Duct with the slot that always pays off. Universal Trol-E-Duct is slotted over its entire length. *So every inch is a potential outlet* to supply needed current for any type of lighting fixture or small tool.

Once Universal Trol-E-Duct is on the job in your plant, there's no need for expensive rewiring, no matter what changes are required. Current is available through twist-out plugs or through trolleys that can be moved

with the lights or tools. Either tap-off device can be removed and reinserted to serve any point along the duct.

And if major alterations call for radical changes in electrical distribution, Universal Trol-E-Duct can be dismantled, moved and reinstalled with *complete re-use of all material*.

You can learn more about this modern, efficient system by calling the nearest BullDog Field Engineer. He can give you full technical information and show you a BullDog installation near your own plant. Or, write BullDog direct and we'll send descriptive folders.

BullDog manufactures Vacu-Break Safety Switches—SoftFuse Panelboards—Superba and Rocker Type Lighting Panels—Switchboards—Circuit Master Breakers—"Lo-X" Feeder BUStrIBUTION DUCT—"Plug-in" Type BUStrIBUTION DUCT—Universal Trol-E-Duct for flexible lighting—Industrial Trol-E-Duct for portable tools, cranes, hoists.



BULLDOG

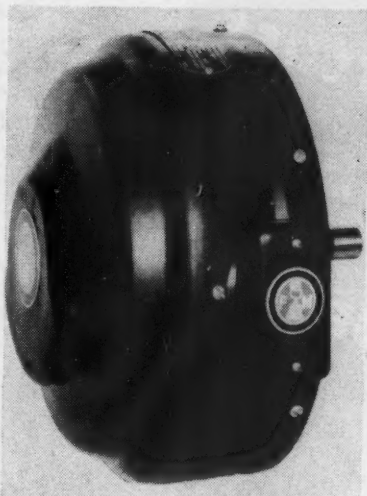
ELECTRIC PRODUCTS COMPANY



Detroit 32, Mich. Field Offices
In All Principal Cities. In
Canada: BullDog Electric Products of Canada, Ltd., Toronto

Axial Air-Gap Motor

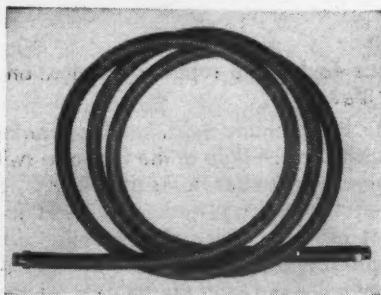
A new type of induction motor, designated as the "axial air-gap motor", has been announced. The magnetic lines of force follow a path parallel to the shaft (or axis of rotation) as compared to the radial path in conventional motors. This feature permits pancake construction with resultant dimensional and weight reductions. An "inside frame" consisting of a hollow cylindrical extension through center of coils supports stator and ball bearings for rotor shaft. Inner race of rotor and bearing is stationary. Stator end bearing is conventionally mounted, fixed in position and is a double row type to take care of magnetic thrust between stator and rotor. A sheet steel drip and splash-proof cover encloses motor. This new line of motors, ranging in size from $\frac{1}{3}$ to 10 hp., is suitable for horizontal or vertical flange mounting, or on an angle base for belt drive. Motors are adaptable to machine tools, integral unit gear motors, textile mills, punch presses, oil well pumping units or any application where physical reduction of motor size is important. Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago, Ill.



FAIRBANKS MORSE MOTOR

Flexible Conductor

A new type water-cooled flexible conductor for transmission of high power, high frequency current has been announced. Construction of the conductor consists of a brass, water-tight convoluted innercore with an outer braid conductor. A specially compounded high frequency flexible insulation is extruded over the outer-braid. Application of the flexible conductor is particularly adaptable to high frequency heating equipment or to any equipment where it is necessary to carry a substantial amount of power at high frequency. Titeflex, Inc., 500 Frelinghuysen Ave., Newark 5, N. J.

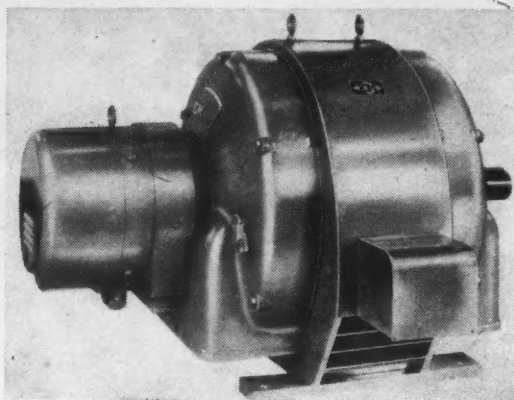


TITEFLEX CONDUCTOR

Splash Proof Synchronous Motors

New heavy duty synchronous motors for constant speed drives up to 1000 hp. are available in splash-proof construction. They are recommended for use in paper mills, chemical plants, mining and milling operations, and for pumping jobs. Brush inspection and blowing out is

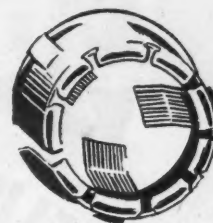
simplified with access plates designed for speedy removal and replacement. Sealed bearings can be cleaned and refilled without motor disassembly. Double end ventilation is provided by a blower on each end of the rotor. Exciter is fitted with blower. Available in unity or leading power factor, with torque and kva. requirements to suit the job. Electric Machinery Mfg. Company, Minneapolis 13, Minn.



ELECTRIC MACHINERY MOTOR

Connector

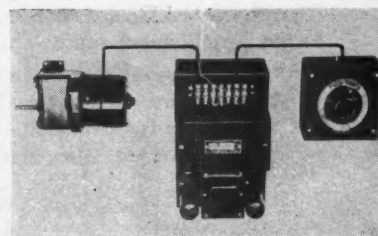
Connector No. 50 is easy to install by inserting it from the inside knock-out of outlet box and pressing firmly with thumb until it snaps into position. Then push non-metallic cable through connector for length desired. It is designed to fit the following cable: 14-2, 14-3, 12-2, 12-3 and 10-2. The connector is made of 25 gauge spring steel and plated against corrosion. Paige Electrical Products Corp., 1 North LaSalle Street, Chicago 2, Ill.



PAIGE CONNECTOR


Remote Servo Control

The Synchro-Link is "packaged" remote positioning servo control that will position one or a number of distant motors according to the setting of the control transmitter. It is for use with



YARDENY SYNCHRO-LINK

fractional or integral hp. motors. A sensitivity control permits adjustment of the accuracy or dead zone. An anti-hunting (anticipating) control is provided for adapting the characteristics of the system to the different values of inertia of motors and loads in various applications. Once set, these controls do not require any attention or adjustment. The synchro-link works on the principle of a self-balancing electronic bridge, consisting of three basic elements—the master control; synchro-link electronic controller, and load control potentiometer geared to the motor or coupled to the load. The controller contacts will handle 15 amp., 110 volt, a-c or 10 amp., 220 volt, a-c. Motors up to 1/10th hp. can be connected directly. Yardeny Laboratories, Inc., 105 Chambers Street, New York 7, N. Y.



NO MORE STARTER SWITCHES

Mean

NO MORE STARTER TROUBLES!

Guth Quick-Liter

TRADE MARK

FLUORESCENT LIGHTING THAT'S SIMPLE!

Ordinary Fluorescent Fixtures, fitted with conventional Starter Switches, frequently result in confusing, high cost maintenance. When Lamps stop burning, it is often very difficult to determine whether the Lamp or the Starter needs replacing.

With GUTH Quick-Liters, there are no Starter Switches—so there are no questions! When a Lamp goes out, it's a dead Lamp! Result—easier, quicker, more certain maintenance. Also, much longer usefulness—

since each Lamp supplies illumination to the end of its life!

Check the many additional advantages of GUTH Quick-Liters:—light at the flick of a switch—start and operate at temperatures as low as 0° F, or on low or irregular voltage—mass-produced for lower initial cost and more economical installation cost. These advantages readily explain why Quick-Liters are the final word in Good Fluorescent Illumination.

WRITE TODAY FOR INTERESTING MATERIAL
ON THE FEATURES OF GUTH QUICK-LITERS

**MANY ATTRACTIVE, EFFICIENT GUTH FLUORESCENT LUMINAIRES
MAY BE EQUIPPED WITH QUICK-LITER BALLASTS**



FUTURLITER **ARISTOLITE** **LIGHTRONICS**

Leaders in LIGHTING Since 1902

★ ★ ★ **THE EDWIN F. GUTH COMPANY** ★ ★ ★

2615 WASHINGTON AVE. ST. LOUIS 3, MISSOURI

Lighting Unit

Two new units have been developed for adding incandescent spot or floodlighting to fluorescent installations. The units accommodate two or four 150 watt, par 38 lamps. Basic chassis of each unit is designed to blend with the LPI four light Constellation fixture. The new Spot-O-Lites supplement the single spot. Each lamp has 360° swivel and 35° angle of projection, and can be focussed independently of the other lamps in the unit. Units can be surface or stem mounted and can be used individually or in between sections of continuous runs. Lighting Products, Inc., Highland Park, Ill.



LIGHTING PRODUCTS SPOT-O-LITE

Instrument

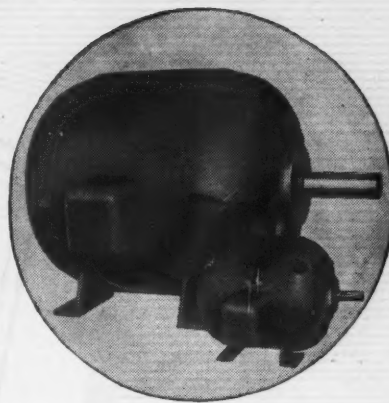
The new Megohmer, Model B-7, is an insulation tester and precision ohmmeter combined, and contains in one instrument two megohm ranges, two ohm ranges and two test potentials for insulation resistance measurements. The ranges are 0-200 megohms at 500 volts d-c, 0-20 megohms at 250 volts d-c, 0-200 ohms and 0-20,000 ohms. It employs a vibrator transformer circuit to step up two No. 6 dry cell batteries connected in series. Batteries are contained in a separate battery and lead compartment in the instrument case. Herman H. Sticht Co., Inc., 27 Park Place, New York 7, N. Y.



STICHT MEGOHMER

Induction Motor

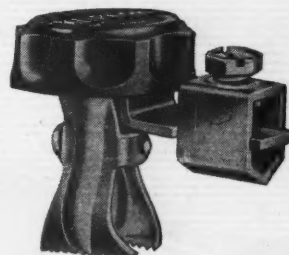
A redesigned line of Series D induction motors in NEMA frame sizes from 203 to 503 has been announced. These drip-proof motors are designed to accommodate either double sealed ball bearings or sleeve bearings. Ventilating openings are below centerline with end air baffles directing incoming air over windings and out at side openings between feet and also below centerline. Integrally-cast fans provide circulations. Burke Electric Co., 273 W. 12th St., Erie, Pa.



BURKE MOTOR

Test Clamp

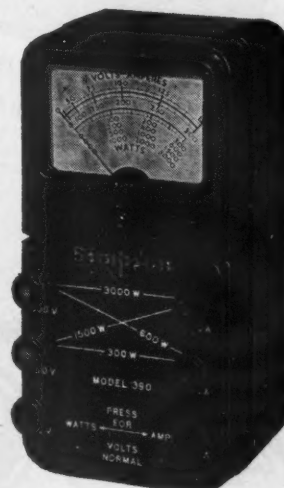
A new U-66 all purpose Kliplok test clamp has been announced. It grips round or flat objects up to 1 inch in diameter or width. Switch will carry up to 150 amps. continuously and 200 amps. intermittently. Solderless lug accommodates No. 2 wire minimum; No. 0 wire maximum and swivels around the clamp, permitting wire or cable to hang in a natural position. It meets the growing need of production and maintenance men for a sturdy, heavy duty, shock proof clamp to be attached to ends of cords on portable equipment such as floodlights, sanding machines, floor polishers, saws, dust collectors, furnace cleaners, drills, welder, etc. Trico Fuse Mfg. Co., 2948 North 5th St., Milwaukee 12, Wis.



TRICO TEST CLAMP

Electrical Appliance Tester

A new electrical appliance tester, known as Model 390, has been announced. The instrument is furnished with a break-in plug which has four color coded leads. Leads are first attached to the instrument, then the plug placed in an electrical outlet and the appliance to be tested is plugged into it. Voltage readings will register immediately. To get wattage or ampere readings, one of two buttons at the bottom of the instrument panel are depressed. Ranges are a-c, 60 cycles; 150-300 volts, 3, 15 amperes, 300, 600, 1500, and 3000 watts. Simpson Electric Company, 5200 W Kinzie Street, Chicago 44, Ill.



SIMPSON TESTER



THE JOHN C. DOLPH COMPANY offers complete information on Preheating, Impregnating and Baking of insulating varnishes. Printed text, charts, schematic drawings and illustrations all included in a handy 12-page reference book. . . . A wealth of accurate and up-to-the-minute data compiled by "Specialists" in the insulating varnish field. It's yours for the asking . . . FREE. Fill in the coupon at left and attach it to your Company letterhead. Your request will be given our prompt attention.

Insulating **Dolph's** *Varnish Specialists*
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 1060 BROAD STREET • NEWARK 2, N. J.

Motor Shops

Turntable For Magnet Wire Reels

Storage and dereeling facilities for magnet wire reels have been combined into a single device by James E. Bailey, in the motor service department of the Electrical Engineering & Construction Co., Des Moines, Iowa. Details of the idea are released by the Award Contest Committee of the National Industrial Service Association.

This handy piece of shop equipment, now being used by the above firm, is a simple octagonal "wheel" that rotates on a stationary base consisting of an I-beam cross (Fig. 1). Spokes and perimeter of the "wheel," made of dual lengths of channel iron mounted back to back, accommodate reel holders spaced at 17½-in., 31¼-in. and 34-in. radii (Fig. 2). Overall diameter of the unit is 6-ft. 8-inches.

Turntable spokes are welded to a large pipe sleeve that rotates about a stationary center (pipe shaft) welded to the base. Positive positioning of reels is accomplished by a locating pin (on stationary bracket) which engages holes on a steel plate mounted to the turntable. Wire tension wheels, mounted on a twin arm supported by a vertical shaft exten-

sion (Fig. 1) are aligned with the winding machines. Dereeling devices can be attached to any reel holder.

The turntable holds 24 reels. Figure 2 lists the sizes most frequently used in this shop; also space for sizes not regularly carried in stock. Use of the unit saves considerable time, Bailey reports. When a winder is finished with one size wire, he simply rotates the turntable until the proper reel comes up and starts the next job.

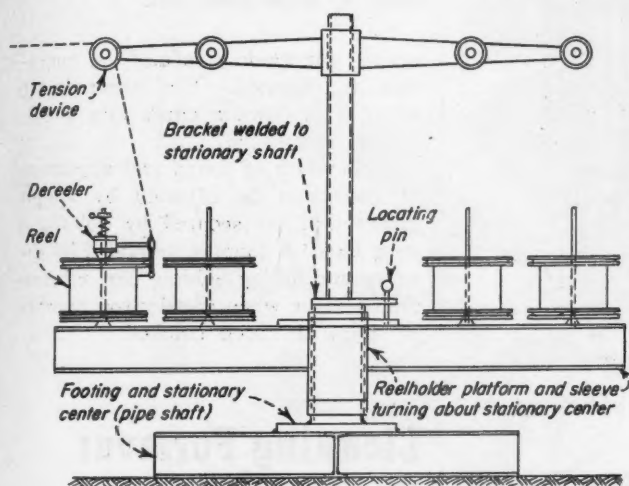


FIG. 1—Sectional view of magnet wire reel turntable showing design and reel mountings on "spoke" of wheel.

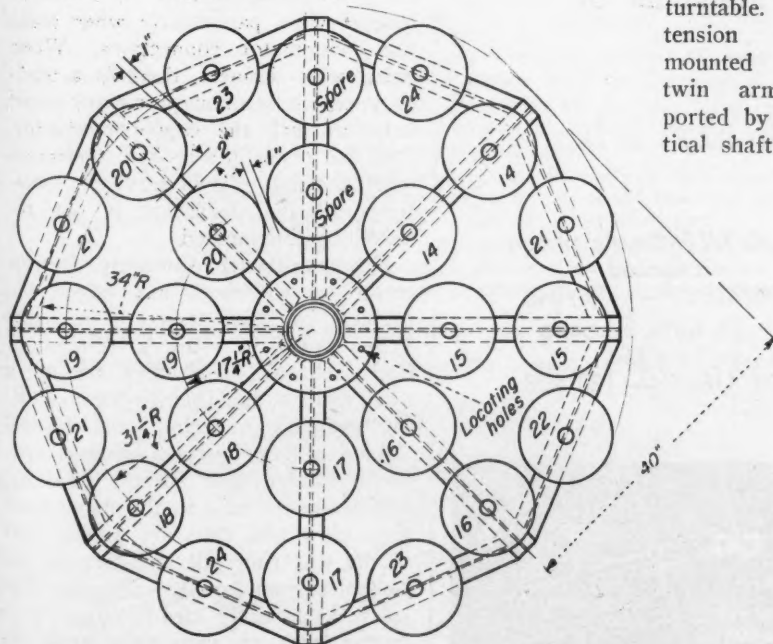


FIG. 2—Top view of turntable showing arrangement of wire reels. Numerals represent wire sizes.

Automatic Shears Cut Stator Top Strips

Stator top strips are cut automatically, evenly and rapidly by a shearing machine designed and extensively used in the shop of the A-C Motor Service, Inc., Jersey City, N. J. The machine combines several engineering principles and operational ideas in a compact assembly.

Power for the machine is from a ¼-hp. motor, belt connected to a worm and gear assembly mounted beneath the rear end of a bed plate. The gear shaft activates two cams and levers at the front end of the machine, the cams raising and lowering a shearing blade and a holding bar that secures the sheet from which the top strips are cut. The sheet is automatically fed forward by yoke mounted pushing fingers that are pulled forward by spring tension. The rising holding bar pushes the finger yoke back on each revolution and spring tension pulls the fingers forward.

When in operation, these pushing fingers push the sheet forward against a guide plate that determines the width of the strips to be cut. During this step, the holding bar and shearing blade are being raised by the rotating cams activated by the gear shaft. The holding bar then descends and holds the sheet firmly in position while the shearing blade evenly cuts the sheet. On the next revolution of the gear shaft, the holder and shearing edge are again lifted, the spring tension fingers are forced back to grasp the sheet, the sheet is pulled forward along the machine bed until it rests

POWER
AND
DISTRIBUTION

DAVIS



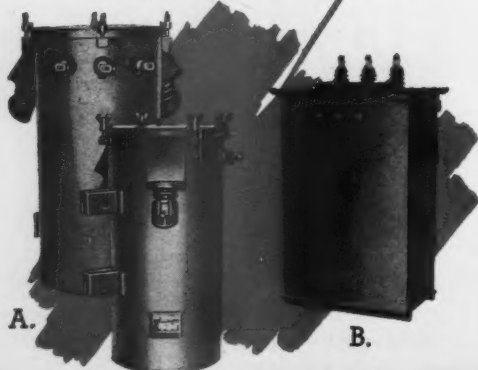
TOP: 1500 KVA — OISC
60 Cycles, 3 Phase
6900/13,800 — 230/460
4 — 2½% Taps at 6.9 & 13.8
RIGHT: 2500 KVA OISC
60 Cycles, 3 Phase
24,000/48,000 — 2400/4800



LARGE

Regardless of the size of the job, every Davis Transformer is engineered and constructed with a sound understanding of the requirements of

UTILITIES **OR** **INDUSTRY**
and is built to give long, continued and dependable service under the most exacting conditions and with a minimum of upkeep and service.



SMALL

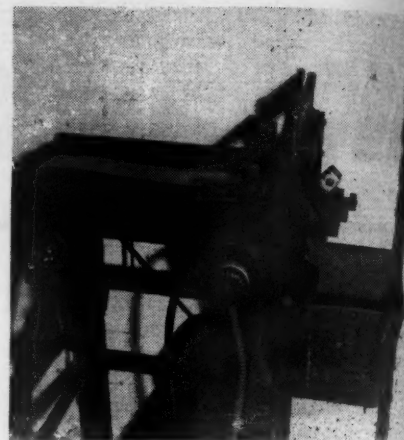
- A. 15 KVA Single phase
oil cooled
2400/4160Y — 120/240
- B. 25 KVA 3 phase
oil cooled
2400/4160Y — 120/208

DAVIS
TRANSFORMER

**DAVIS
TRANSFORMER CO.**

Phone 177 CONCORD, N. H.

MANUFACTURERS OF OIL COOLED, DRY TYPE,
POWER AND DISTRIBUTION TRANSFORMERS



Top strips are cut by machine powered by fractional hp. motor and worm gear assembly. Cams activate cutting blade, holding bar and spring tension sheet pushing fingers. Simple adjustments regulate alignment of sheet and width of strips being cut.

against the guide stop and the operation is repeated. The sheared top strips slide down a chute into a collecting receptacle.

Both width of strips and alignment of sheet can be adjusted by simple guides that are secured by bolts and wing nuts. A counter, activated by the rising and falling holding bar, informs the operator when the desired number of strips has been reached.

Cleaning Formvar Magnet Wire

Many motor service shops have experienced some difficulty in cleaning the synthetic insulation off Formvar magnet wire, particularly when making commutator connections. When using wire skimmers, there is a tendency, especially among less experienced help, to nick the copper conductor. This can result in a broken connection when the motor is in service. Sometimes all the insulation is not removed by this method.

Howard Electric Company, Detroit motor service shop, has solved the problem by using heat and solvents. When ready to clean a number of leads, Howard mechanics set up a torch and two containers—one containing ordinary soldering salts (Excel Soldering Salt) and the other, a synthetic alcohol type solvent (Solox). The leads are held in the flame until they glow red, then are dipped first in the soldering salt and then in the alcohol solvent for final cleaning. Result: A perfectly clean copper conductor with no dangerous nicks or cuts.

The torch and a stop-block (for the

UNITED STATES RUBBER COMPANY

SERVING THROUGH SCIENCE

"I ain't no ordinary turtle!"



RU
wiring with
RU?
it's the coming "Code" wire

And Laytex (Type RU) is no ordinary wire. In physical and electrical properties, no other branch circuit building wire can compare with it.

Not only that, but Laytex is smaller in diameter than any other rubber insulated building wire. This means that in re-wiring, each conduit can hold more circuits—a wire man's dream come true.

Laytex (Type RU) is insulated with laminated walls of 90% unmilled, grainless natural rubber. The conductors are perfectly centered in this homogeneous sheath, thereby avoiding any chance of thin spots.

Scientists of United States Rubber Company have carefully compounded Laytex so that it is lighter in weight, easier to handle and install. The saturated cotton fibrous cover is flame-retardant and moisture-resistant.

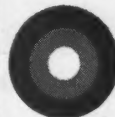
UNITED STATES RUBBER COMPANY
1230 Avenue of the Americas • Rockefeller Center • New York 20, N. Y.

U.S. LAYTEX — — —

Specify *RU* **Laytex***

ELECTRICAL WIRES

SAFETY FACTORS THAT PUT *RU* OUT IN FRONT



BULL'S EYE

The conductor is on dead center throughout every inch of the wire.



ELEPHANT INSULATION

Laminated walls of tough natural rubber insulation mean Laytex is safe.



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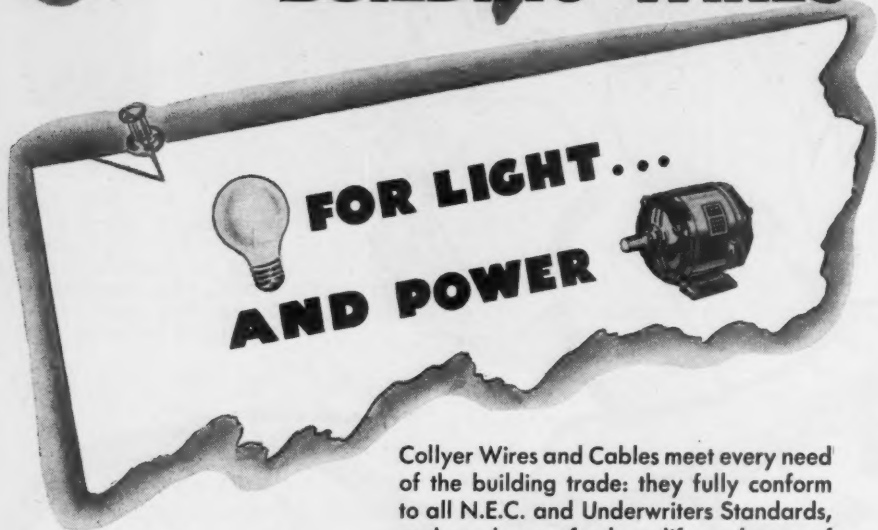
Allows more circuits per conduit than in ordinary wire. Lighter weight.



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Braids are impregnated and finished for flame and moisture resistance. Specify Type R for dry locations and temperatures up to 50° C.; Type RH insulated with heat resisting synthetic rubber, for temperatures up to 75° C. Available in braided or lead covered construction for voltages to 5,000 or higher with sizes #14 to #8 solid or stranded, size #6 and larger, stranded.



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leads) are fastened in a bench vise to leave both hands free to hold the coils and dip the heated ends in containers. A final wipe with a cloth and the leads are ready to be installed in the commutator.

Locating Shorts With Adjustable Studs

Armatures of small and medium diameter are checked for shorts on a shop made testing assembly in the armature department of the A-C Motor Service Company, Jersey City.

The shaft of the armature being tested is rested on a pair of supporting cradles. One of these cradles is fitted with pivoted, insulated studs which can be raised or lowered to accommodate commutators of various diameters. Battery leads are connected to these studs and the studs are adjusted so that their contact points rest on the surface of the commutator.

The current used for testing is from a 6-volt battery. The current is passed through the small commutator section between the contact points of the studs. The incremental drop between individual bars of the commutator is checked with a millivoltmeter. After each series of checks and meter readings, the armature is rotated slightly in the cradles until all of the bars have been tapped or until the short has been located.

All component parts of the assembly were designed and fabricated in the shop. The use of the equipment is simple and time saving.



Shop assembly facilitates testing small armatures for shorts in the shop of the A-C Motor Service Company, Jersey City, N. J. Current from 6-volt battery passes through insulated contact studs to adjacent points on commutator surface. Incremental voltage drop between bars is checked by millivoltmeter.

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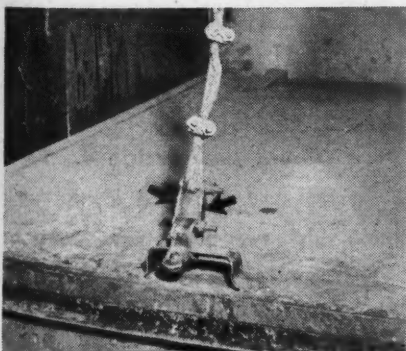
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Reel Rack Made From Channels

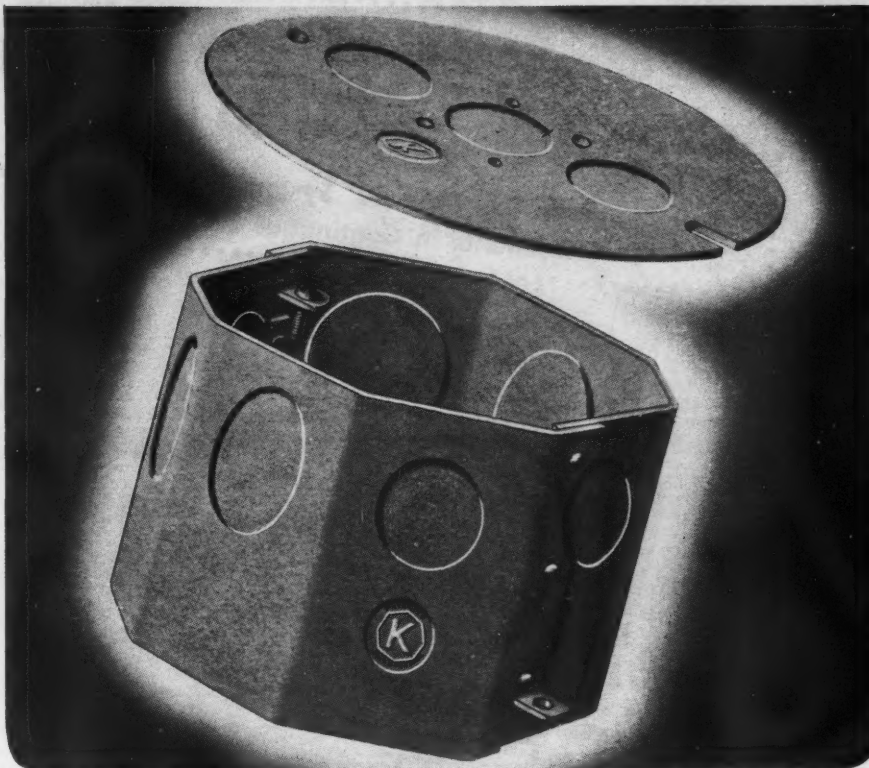
Wire reels are stored neatly and securely in the shop and five-story warehouse of the Electric Apparatus Repair Company, Philadelphia. Standard six-inch iron channels, with flanges pointing upwards, are welded at either end to similar channels placed vertically. Horizontal members are spaced at varying intervals to accommodate reels of varying diameters. Upright members are mounted on large-area floor plates which distribute the load over the adjacent floor area, and are secured to overhead beams to insure the upright position of the frame assembly. Reels, stored between the horizontal channels, are prevented from rolling by the upturned flanges of the supporting channels.

In cases where reels are considered too bulky or heavy to be safely or easily lifted by hand, an overhead monorail crane, mounted a short distance in front of the storage rack and equipped with a chain hoist and sling, provides the means to easily raise and lower the reels.



Fire safety feature on dip tank cover at Howard Electric Company, Detroit. Should a varnish fire occur when cover is open, fuse metal links (arrows) between handle and counterweight cable will melt and cover will drop to snuff out flames.

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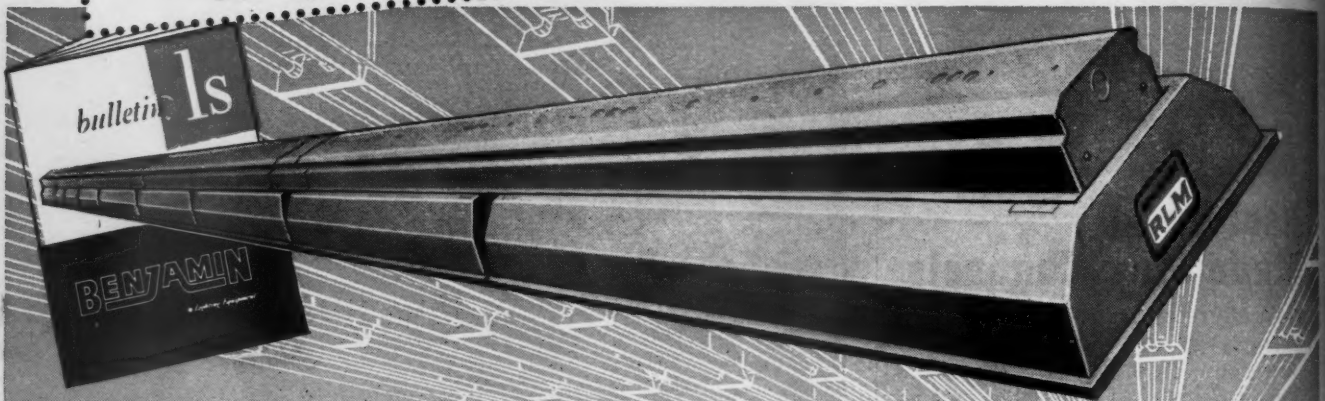
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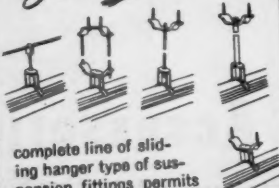
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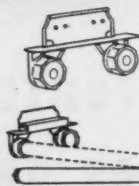


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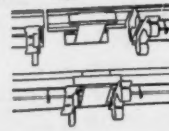
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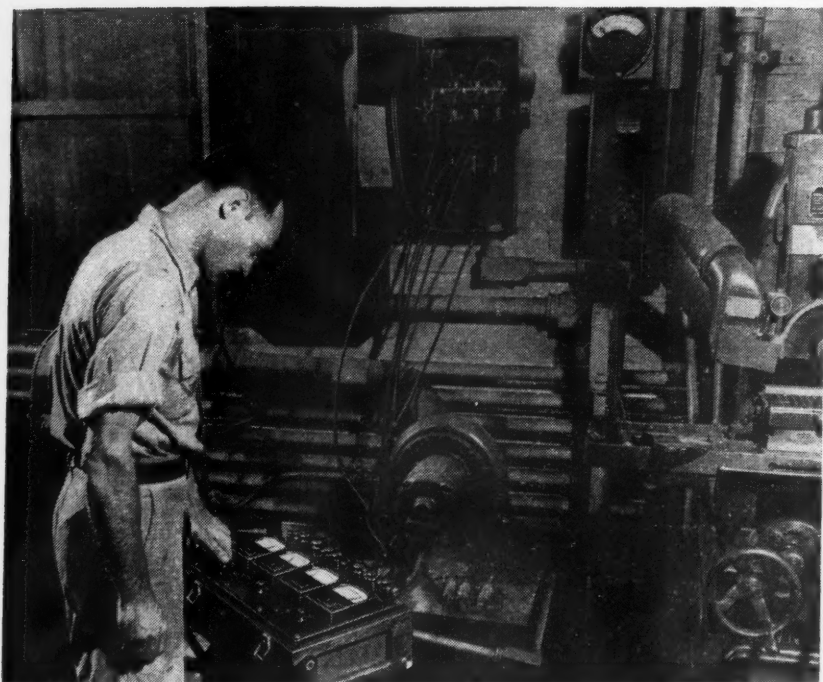


Industrial Electrification

ENGINEERING • INSTALLATION • MAINTENANCE

Electrical Indicating Instruments—Part I

By Lawrence F. Parachini
Educational Engineer
Weston Electrical Instrument Corp.
Newark, New Jersey



Maximum electrical efficiencies and economies are achieved only when power characteristics conform to standards of design. Accurate knowledge of such data can be obtained only by the use of reliable indicating instruments.

MAINTENANCE is as much a part of manufacturing as production. On this premise, the delivery of power to a machine, for example, is as important and as much a manufacturing function as the delivery to the same machine of the material to be processed.

We are all familiar with, and agree with, the testing and inspection techniques involved in manufacturing processes but do we recognize and apply similar procedures to maintenance work in order that primary function of the organization, that of producing the maximum output at the minimum cost, is accomplished?

From a maintenance man's point of view this task is one of very close regular inspection of all parts of the plant and its operating equipment. Nothing should be overlooked. Daily, this simple requisite becomes more complex and the need for adequate tools is increasingly emphasized.

The day of the electrician's finger test is gone. Exactly how much voltage is the question, not merely does it exist. How much, because of its relation to efficiency of operation of such things as lamps and motors and because of its effect on insulation life. Proper tools, such as electrical indicating instruments, which take the guess-work

out of maintenance, are necessary.

Electricity is the motivating force in most manufacturing procedures and knowledge of its presence and extent, as well as means for its control, must be available in order to utilize it wisely and economically. The electrical instrument is a basic tool available to the maintenance man to obtain essential information about electrical circuits. This series of articles is presented as an aid to better understanding of these important tools.

The electrical maintenance man today is confronted with such widely divergent tasks as the measurement of a few microamperes or millivolts and thousands of amperes and volts. Frequency, in a-c measurements, is no longer just 60 cycles but may vary to many million cycles in industrial electronic equipment, such as induction and dielectric heating devices. Such circuit parameters as resistance, capacity and inductance are his concern. Measurement of light and the utilization of it not only for seeing but for control of processes are his problem.

Instruments applicable to these tasks, and many others, encompass the gamut of instrument types and associated accessories.

INSTRUMENT MECHANISMS

Basically, most all electrical indicating instruments incorporate one of three fundamental mechanisms. All have one thing in common, that is, they operate by virtue of an electromagnetic reaction, produced by a current being measured. To state this in another way, practically all instrument

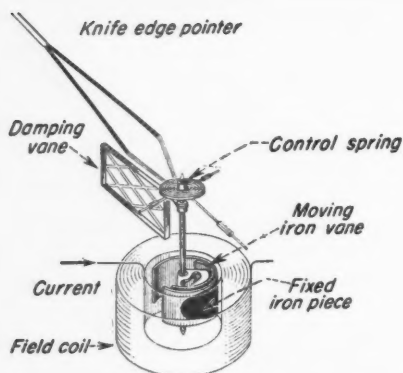


FIG. 1—Moving iron vane mechanism.

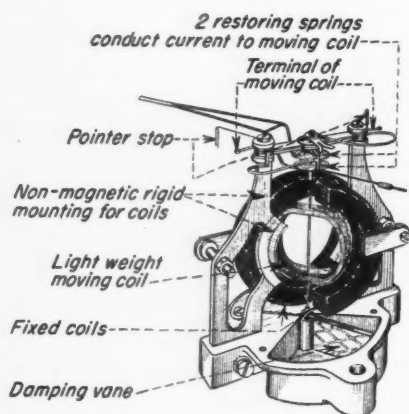


FIG. 2—Electrodynamometer mechanism.

mechanisms are current sensitive. It matters little what quantities are indicated on the scale whether volts, watts, rpm., degrees Fahrenheit or minutes to curl blonde hair, the pointer location on the scale is the result of a current applied through the basic mechanism. The conversion of the quantity to be measured to a current is accomplished by additions to the basic mechanism of such things as series resistors, magnetos, thermocouples, photonic cells and the like.

These three most important and widely used mechanisms are:

1. Moving Iron Type. (Fig. 1)
2. Electrodynamometer Type. (Fig. 2)
3. Permanent Magnet Moving Coil Type. (Fig. 3)

Complete instruments incorporate one of these mechanisms and in addition, any necessary associated apparatus such as resistors, shunts, rectifiers, etc., which are required by the quantity to be indicated on the scale. Often the associated apparatus is external to the instrument proper because of its practical limitations of size, heat, dissipating ability, voltage protection and other special considerations but it should always be considered as part of the complete instrument.

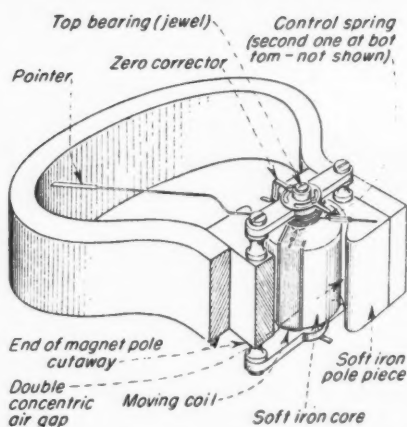


FIG. 3—Permanent-magnet moving coil mechanism.

TYPES OF INSTRUMENTS

Indicating instruments fall into four general classes:

1. Laboratory Standards.
2. Portable Test Instruments.
3. Switchboard and Panel Instruments.
4. Test Equipment.

Laboratory standards, as the name implies, are instruments to be used for final reference, against which all plant test instruments are to be checked. In this category are the 1 percent permanent magnet (d-c) type and the electrodynamicometers (a-c and d-c) type as well as any others which, by virtue of their accuracy with relation to the service instruments, are classed as standards. These instruments should be set up on a permanently installed basis in a room having a relatively constant temperature and free from vibration and dust.

Portable test instruments constitute by far the most important group for maintenance work. Included are all types of d-c and a-c ammeters, voltmeters and wattmeters, as well as such special instruments as frequency and power factor meters. Portable instruments should be suitable for use in all locations of the plant and, therefore, must possess ruggedness, flexibility, good temperature characteristics and shielding. Guaranteed accuracy ranges from $\frac{1}{4}$ to one percent. As a rule, they are provided with knife edged pointers and mirrored scales to permit accurate reading. Most portable instruments are made for horizontal use and cannot be depended on to the same accuracy if used at an angle or in the vertical position.

The third classification, switchboard and panel types, applies to those instruments made for permanent installation. They are available in many shapes, sizes and mountings. Accuracy, in general is of the order of 1 and 2 percent and the scales and point-

ers are arranged for good visibility. Vertical mounting is normal for this type although other positions are practical without change in accuracy.

Units such as a-c, d-c multimeters, power circuit analyzers, vacuum tube testers, insulation testers and sound and vibration measuring devices are included in the test equipment classification. These instruments represent, on one hand, an almost infinite number of measuring ranges and, on the other, special purpose equipment of a very complicated nature. The use of these instruments, however, is a very necessary part of the maintenance procedure. Convenience is the prime objective, accuracy is usually secondary. The clamp-on-ammeter is a good example of this; 1 percent accuracy is sacrificed for the ability to make measurements of current without cutting into the line.

SELECTION FOR JOB

Selection of the proper instrument to fit a job is a very important matter and should depend solely on the job to be done when weighed with cost of instruments, time involved in use, labor and other factors.

Some factors to be considered are:

1. Type of source; a-c or d-c.
2. Quantity to be measured; amperes, volts, frequency, illumination.
3. Type of service; portable, switchboard.
4. Scale length.
5. Accuracy desired and under what conditions.
6. Range, including external accessories such as shunts, multipliers or transformers.
7. Frequency coverage (a-c measurements).
8. Temperature effects.
9. Shielding, especially portable instruments of high accuracy.
10. Damping and response time.

Consideration of the above factors in some detail will aid in proper instrument selection.

The type of power must be known since some types of instruments will work on only one. D-c permanent magnet instruments are not usable on a-c unless coupled with rectifiers or thermoelements. Moving iron instruments will indicate on d-c but not with the same degree of accuracy as on a-c. Electrodynamicometers will be equally as good on d-c as a-c.

Scale length will be determined from such factors as accuracy desired, whether small incremental changes must be detected, reading distance involved and overall range utilization.

Accuracy will depend on the job to be done. Naturally, greater accuracy

is always desirable but often achieved only at greater cost in equipment, time and labor. It is unreasonable to use a $\frac{1}{2}$ percent instrument, for example, to measure values which need not be held better than 5 or 10 percent as is often the case in electronic equipment. On the other hand, a 2 percent instrument is unsatisfactory for measurement of power or for voltage measurements as applied to lamp and motor loads.

Damping and responsiveness as a rule need not be considered further if a reliable product is used. Most instrument manufacturers build into their instruments sufficient damping and enough speed to provide optimum results. Good damping is such that the pointer gives several over swings before coming to rest. There are special applications where damping becomes an important factor. For example, a highly damped, slow ammeter must be used in pump circuits where the frequency of pumping is low, otherwise, the pointer will follow the pump beat and make it almost impossible to read the current.

Protection from the effects of external magnetic fields, created by current in conductors or emanating from electromagnetic devices is very necessary, especially for accurate portable instruments. Shielding affords this protection by shunting the field around the instrument mechanism. Magnetic fields will effect indications in various ways.

a. A strong d-c field will cause a d-c instrument to read high or low, depending on direction but will not effect a-c measurements made with an electro-dynamometer.

b. A strong a-c field will tend to produce a permanent error in a d-c instrument by demagnetizing the magnet but will not introduce a transient error. For a-c measurement, however, it will cause errors depending on the phase and position.

Temperature effects must be considered especially for potential measuring instruments since indications may change with ambient temperature variations. In general, reliable instruments will hold their basic guarantee over a temperature span of 60 to 95 degrees F. It is often necessary to consider greater spans than this and the following example may serve as a guide.

It is often necessary to make voltage tests outdoors where the temperature may vary from minus 20 to plus 120 degrees F. depending on the season. A normal 150/300 volt ($\frac{3}{4}$ percent guarantee) a-c instrument has a temperature error on the 150 volt range, for example, of approximately 0.5 percent for 18 degrees F. change. Thus at minus 20 degrees F., it will be off

approximately 2.5 percent while at 120 degrees F. it will be 1.4 percent off in the opposite direction. For this application a special temperature compensated instrument is desirable.

A-c frequency is always a factor to be reckoned with, particularly in the measurements of voltages. Standard a-c voltmeters of the moving iron and electro-dynamometer types, must be especially compensated for values beyond about 125 cycles; ammeters beyond 500 cycles. In either case, these types cannot readily be used beyond 3000 cycles. At higher frequencies, rectifier or thermocouple instruments are necessary. It is important to recognize that all a-c instruments must be selected and used on the basis of their frequency response as well as the quantity to be measured.

INSTRUMENT ACCESSORIES

No picture of electrical indicating instruments is complete without including some discussion of the more common accessories. They serve to expand the utility of self-contained instruments by providing additional ranges, by providing ranges beyond the scope of self-contained possibility and by providing protection to the user.

Shunts: For d-c current circuits only. (Fig. 4)

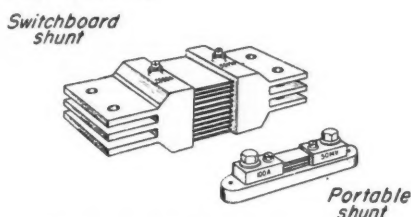


FIG. 4—Shunts for d-c circuits.

In addition to increasing range of d-c ammeters, these uses are of interest.

- More than one indicator can be used per shunt.
- Remote indication can be had without carrying primary circuit to that point.
- Provides permanent installation of shunt with removable instrument.

Multipliers or resistors:

For a-c and d-c potential circuits. (Fig. 5)

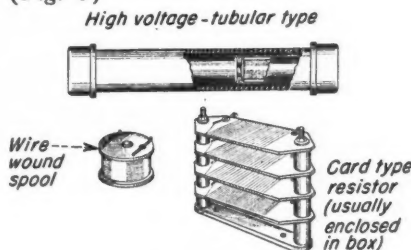


FIG. 5—Series resistors for voltmeter use.

At this point it is well to define a distinction between a "multiplier" and a "resistor." Both units look alike and are basically the same. The distinction comes in their use.

An external resistance unit is called a multiplier when it multiplies the range of the instrument with which it is used. That is, the range available is not figured on the scale.

An external resistance unit is called a resistor when it is necessary with the instrument to obtain the range figured on the scale.

Besides extending or increasing the potential range of instruments, resistance units afford means of measuring high potentials not safely applied to the instrument proper.

Current and potential transformers—a-c only. (Figs. 6 and 7)

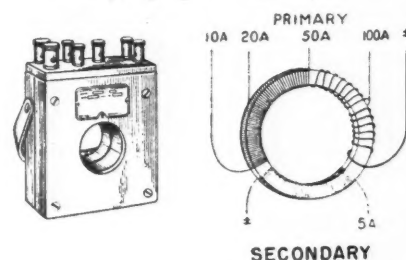


FIG. 6—Current and potential transformers for a-c instruments.

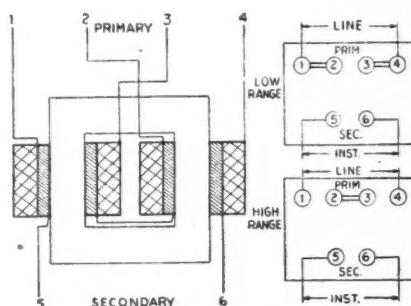


FIG. 7—Potential transformer arranged with means for connecting the two primary coils in multiple or series, providing two ranges in a 2-to-1 ratio. A single secondary winding is used.

Transformers are the most practical means of extending ranges of moving iron and electro-dynamometer type a-c instruments. In addition, they serve to reduce cost by providing use of more than one instrument per transformer. This is important when power measurements are made involving current, voltage, power and power factor. Instrument isolation from the main lines is also achieved as well as means of remote indication.

Special Accessories—

Rectifiers, copper oxide type.

Thermoelements—For high frequency current measurements.

Thermocouples—For temperature measurements.

Magnetos—For speed measurements.
Photronic Cells—For light measurements.

These accessories and their use will be discussed in a subsequent article because of their special characteristics and uses.

WHAT INSTRUMENTS SHALL I USE?

The number and kinds of instruments a maintenance man should have will vary greatly and depend on many factors such as size of plant, type of product, type of manufacturing equipment and many others.

The subject is so broad and important that it will be elaborated on in a subsequent discussion.

As a guide now, however, a specific example can be illustrated. Consider the requirements for the following case:

Plant has 2300 volt, 3 phase, 3 wire service. It is stepped down and distributed at 440 volts to motors ranging in size from $\frac{1}{4}$ to 100 horsepower. The small motors are run on 110 v single phase as well as the lighting load. Welding and heating loads are also involved to a small extent on an intermittent basis.

The essential instruments would be:
Voltmeters

Type: Portable a-c moving iron type
Pointer: Knife edge pointer and mirrored scale

Accuracy: $\frac{3}{4}$ of 1 percent

Range: 150/300/600 volts

Frequency: 25-125 cycles

Note that a 300 volt range is included. This is available at practically no increase in price and gives greater coverage on the basis of 2 to 1 ratio of ranges.

Ammeters—two required

Type: Portable a-c moving iron type
Pointer: Knife edge with mirrored scale

Accuracy: $\frac{3}{4}$ of 1 percent

Range: One with ranges of 0-.5/1 amp. Other with ranges of 0-2.5/5 amp.

Frequency: 25-500 cycles

Note: Even though only up to 125 is necessary, the standard ammeters cover up to 500 cycles.

Wattmeters

Two possibilities exist: One, the use of a polyphase instrument and, second, two single phase instruments to be used in the two wattmeter method of polyphase power measurements. Of the two choices, the second seems to provide the greatest flexibility.

Either—

Type: Single phase electrodynamic meter

Pointer: Knife edge with mirrored scale

Accuracy: $\frac{1}{2}$ of 1 percent

Range: Watts: 250/500/1000/2000
Current: 2.5/5 Normal, 3.75/7.5 Max.

Voltage: 100-150/400-500

Note: Two of these instruments would be required.

Or—

Type: Polyphase electrodynamic meter

Pointer: Knife edge with mirrored scale

Accuracy: $\frac{1}{2}$ of 1 percent

Range: Watts: 500/1000/2000/2500/5000

Current: 2.5/5 Normal, 5/10 Max.

Voltage*: 100/200/500 Normal, 150/300/600 Max.

*Note: this voltage combination chosen because it is standard. The additional range is available at no increase in price.

CURRENT TRANSFORMERS

Two portable current transformers are required to extend the current range of the ammeters and wattmeters to ranges sufficient for the large motors.

Type: Portable

Range: 10/20/50/100 to 5 amperes self-contained and up to 800 amperes with inserted primary.

Capacity: 5 volt-amperes.

Accuracy: Suitable with $\frac{1}{2}$ and $\frac{3}{4}$ of 1 percent instruments.

Instead of the above listed individual instruments and transformers which offer the greatest flexibility and accuracy, a single unit such as an industrial power analyzer can be used. An analyzer provides the convenience of a single unit and simplifies connections and use. It is a timer saver.

A 3-phase, 3-wire analyzer, such as a Model 639 Weston, would provide ranges as follows:

Current: 5/25/125 amperes

Voltage: 150/300/600 volts

Watts: 1/2/4/5/10/20/25/50/100 kilowatts

Power Factor: .3-1.0-.8

Accuracy: 1 percent for voltage, current and power factor, 2 percent for watts.

In addition to the essential instruments, the following would be desirable:

1. Clamp-on ammeter for quick every day plant use.

Ranges: 10/25/50/100/250/500 amperes.

2. Ohmmeter, for general circuit continuity testing and such tasks as testing of motor windings, transformer windings and the like.

Ranges: 0-10 and 0-1000 ohms.

3. Illumination or sight meter for lighting surveys and for use around the plant to provide adequate illumination for each specific task.

Range: 0-75 footcandles.

USE AND CARE

Instruments, in common with all tools, must be used properly and correctly cared for if long life and accurate reliable results are to be obtained. As a matter of fact, instruments are uncommon tools in that they have almost indefinite life. Many are now in service that are over 50 years old.

Proper procedure in setting up and making tests is important and the following factors should always be considered:

1. Avoid locating instruments where dirt, vibration and possible shock conditions are present.

2. Avoid placing instruments on the floor. Make sure that instruments are placed in their correct position. Portable instruments in the horizontal, etc. Provide good lighting to avoid reading errors.

3. Place instruments as near apparatus to be tested as possible. This eliminates long leads which are always a source of trouble, both from an electrical standpoint and due to the possibility of entanglement with equipment and personnel. One point to keep in mind, however, is that stray magnetic fields are to be avoided.

4. Use insulated wire of adequate size for the current to be measured. This is particularly important in conjunction with d-c external shunts. Make all connections firm.

5. Before applying power to the instruments, check to be sure that the pointers are on zero. (This doesn't apply to power factor meters or frequency meters.) Use the zero correctors to set them on.

6. Provide circuit protection whenever possible. Take care, however, that the addition of this protection does not affect the instrument accuracy. Fusing of instruments is a very special problem to be studied because of the undesirable aspects introduced by virtue of fuse characteristics of resistance and burn out time. In general, indicating instruments are sturdy enough to take short time overloads.

7. Don't clean scale glass just before applying power unless you "breathe" on it after. Rubbing the glass with a cloth will generate static changes which attract the pointer and cause incorrect indications. This is particularly true on dry days and for very sensitive instruments. Breathing on the glass will discharge it.

8. Avoid parallax or reading errors. With a mirrored scale this can be done readily by aligning the image of the pointer with the pointer. For unmirrored scales, align the eye normal to the pointer.

9. If external accessories are used,



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which change the range of the instruments, take direct readings from the scale and apply multiplying constants later. When making extensive surveys or regular periodic tests, record all data, including serial number of instrument.

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Finally, repairs to instruments should not be undertaken unless done by skilled instrument men. Much repair will be of a minor nature but may result in excessive cost in the hands of the unskilled. This work requires, besides manual dexterity, wide knowledge of electricity and appreciation of design. In addition, special tools and equipment are necessary.

The second article on this subject will discuss specific problems, the use of instruments to obtain practical information and the application of this knowledge.



New blood in the form of more trained apprentices is needed in the electrical trades, Frank W. Jacobs, vice-president, District Eleven, IBEW, St. Louis, tells contractors at recent NECA Division Four meeting in Chicago.

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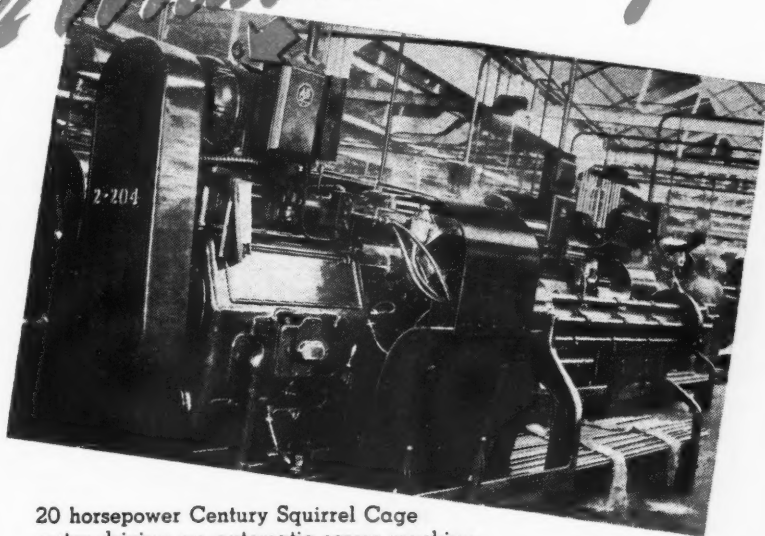
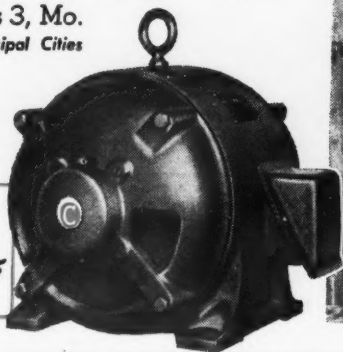
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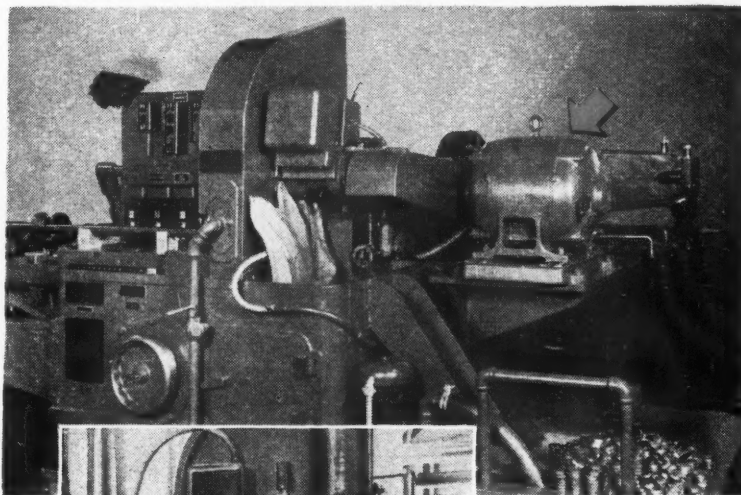


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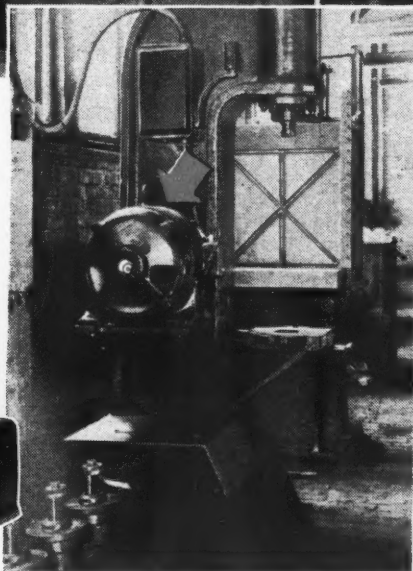
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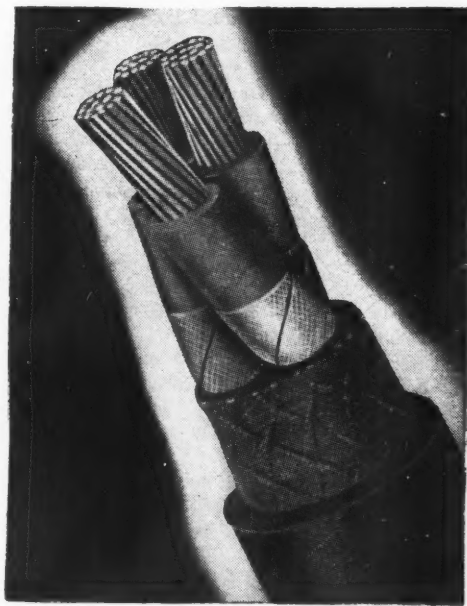
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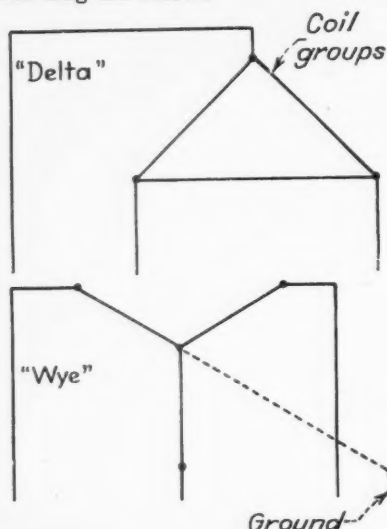
Horsepower Rating

QUESTION 253—How would you find the horsepower and operating voltage of a motor one phase, two phase or three phase if the name plate was lost?—H.B.S.

A. TO QUESTION 253—Connect the motor to a low voltage, to bring it to full speed. Measure speed. Compare shaft size and weight of motor with a standard motor to get the horsepower. Now, with an ammeter in 1 lead, load the motor, starting with the lowest voltage, and going to other voltages, till you reach a point where the hum and current is normal to get the correct voltage. A time test will serve as extra proof of voltage and horsepower because some motors are made special.—H.S.

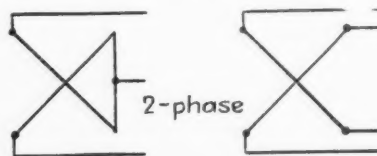
A. TO QUESTION 253—This question cannot be generalized and the following considerations are minimum for the understanding of the problem as stated.

First determine phase connection by inspection. For 3 phase, synchronous or induction there are generally three "operating leads," Delta or Wye as illustrated. If the Wye is grounded making a 4th lead it is easily noted. See diagram below:



From any external lead trace circuit to any other of the external leads. If one coil group is passed through, winding is Delta and if more than one coil group is passed through, winding is Wye. (A coil group consists of one or more coils and its terminus is indicated where three or more wires are connected at a common point).

For 2 phase, sync or induction. (3 or 4 external leads) Left diagram below shows a 3 wire "interconnected" while the diagram on right indicates



a 4 wire "non-interconnected." A connection trace will quickly indicate if 2 phase.

For single phase (2 external operating leads). These motors, particularly in the larger sizes are characterized by some sort of a centrifugal switch mechanism. Those that are not are invariably of the fractional horsepower sizes and could be either single or polyphase. If polyphase stator windings would coincide as a Delta or Wye as above mentioned—otherwise a split-phase or shaded pole unit would probably be the answer, in any case single phase would be the answer.

Knowing the phase we must now obtain the voltage which must be derived by test. (60 cycle is safe to assume—any 50 cycle motor of liberal rating will operate on 60 cycles with same rating.) Single phase and 2 phase motors are generally for either 110 or 120 volt operation while three phase are generally for 220, 440 or occasionally 550. (2200 volt operation is evidenced by heavy insulated leads and high horsepower sizes). Since all units are tested similarly, let us illustrate with a 3 phase motor: First, test with 220 volts (no load) with an ammeter on input side. If motor is really for 440 volts there will be practically no current indication while if it were really for 220 volts, a definite current indication would result.

Confirming test: This time apply a restraining force on motor pulley and apply 220 volts. If motor is really a 440 volt unit you can hold rotor but if motor was really a 220 volt unit, you couldn't hold rotor stationary. Incidentally, a 2200 volt motor on 220 wouldn't even start. (Any 440 volt motor which operates more efficiently on 550 by test, can be so labeled.)

Next by compass obtain number of poles and in turn get rpm, equalling frequency times 60 divided by number pairs poles. Lastly, by prony brake obtain horsepower:

$$\text{Horsepower} = \frac{\text{Torque at 1 ft. radius times rpm.}}{5252}$$

—E.A.M.

A. TO QUESTION 253—Single phase motor. Note the leads brought out from the motor. It can be determined on 110-220 voltage by the leads. Applying a single phase voltage and checking with a voltmeter in parallel to the circuits and an ammeter in series, the proper voltage can be determined. Checking number of poles for proper speed, with ammeter reading will determine the horsepower rating with properly applied load. Heating will take place with too high a voltage, and no power with too low.

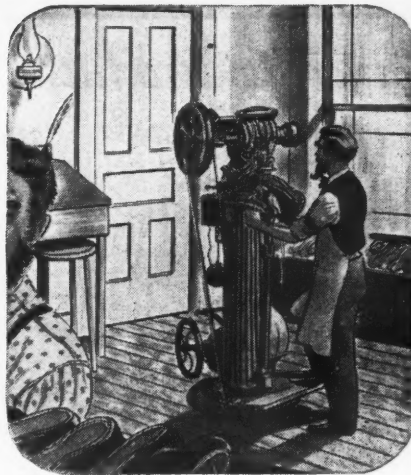
Two or three phase. Note insulation if high or low voltage. If low voltage, check leads brought out. Many motors are dual voltage. Example: 440-220 volt motor with nine leads. By applying three phase current and taking an ammeter reading, the approximate voltage can be determined. In testing, if voltage is too low, it will not turn motor, or will have little power. If too high voltage, fuses will burn out, or motor will heat. By checking ammeter reading and voltmeter reading, approximate load can be applied and horsepower rating can be found by ammeter reading or 30% can be added to the no load reading. Two phase motors have approximately 25% more total turns than a three phase motor, so the improper phase can easily be determined.—E.H.



1 1851—John Nichols, a Lynn Shoemaker, adapted the Howe sewing machine to sew the uppers of shoes, doing away with the slow process of hand sewing. This started a fever of invention and innovation in the shoe industry in America that has carried to the present day.



2 1858—Lyman R. Blake, of South Abington, Mass., invented a machine to sew soles to uppers. This was subsequently improved by Robert Mathies and manufactured by Gordon McKay. It became famous as the McKay sewing machine . . . set the stage for more progress.



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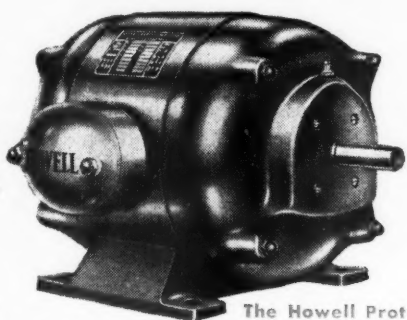
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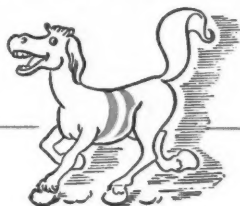
Be wise—meet competition with modern machines powered by industrial type Howell Motors. They're precision-built!



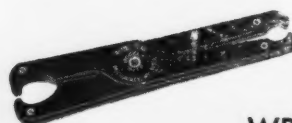
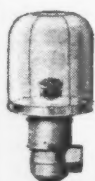
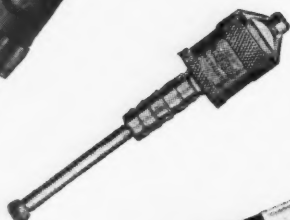
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Bench Grinder

QUESTION 254—What will cause a single value capacitor type, squirrel cage motor, operating as a bench grinder, to fail to start at a certain position of the rotor? Moving the rotor a small fraction will cause it to start. The motor is $\frac{1}{4}$ hp., 110 volt, 60 cycle, 3.8 amps, operating at a speed of 3450 rpm. The capacitor is rated at 8 M.F.D.—330 volts. How is this value of capacitance arrived at? In substituting capacitors would it be safe to use the formula:

$$\text{M.F.D.} = \frac{2650 \times \text{amperes}}{\text{applied volts}} = \frac{2650 \times 3.8}{110}$$

—91. M.F.D.

New bearings and a new capacitor of the same value have been installed with the same result. A capacitor of much higher value, 400-450 M.F.D., 110 volts, was tried and the motor took right off, but seemed to have poor pull-in torque.—E.J.M.

A. TO QUESTION 254—I have had the same trouble with a single value capacitor type, squirrel cage motor, operating as a bench grinder as described by E.J.M. After checking the capacitor for short, open, grounds, capacity in M.F.D., etc., the condition persisted. A change in capacitor did no good. Here, let me state that using a capacitor that is too large may not injure the capacitor, but the pull-in torque of the motor may be adversely affected. Also, using a capacitor of a smaller M.F.D. rating will increase the voltage across the capacitor. The inductance of the auxiliary winding is in series with the capacitor and as capacitance is reduced, series resonance is approached, increasing capacitor voltage. The real trouble lays in the rotor not in the stator. See that the ends of the copper bars are brazed to the rings at each end of the rotor spider. Loose bars cannot carry the large currents necessary in producing starting torque. By all means, if rotor fails to start in certain positions, this is the trouble.—J.W.J.

A. TO QUESTION 254 — One (or more) of the shunt bars in the armature is open. If the armature uses aluminum bars, then repair is impossible, since they crack internally (within the rotor). If copper bars are used, it may be possible to repair by resoldering or brazing the joining ring on each end of the rotor. There is not much use hunting for the exact bar, just go over the entire assembly. Of course, a new armature will cure the condition.—S.G.B.

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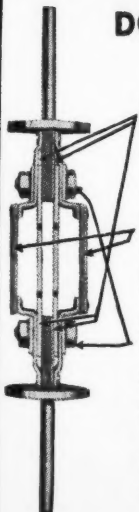
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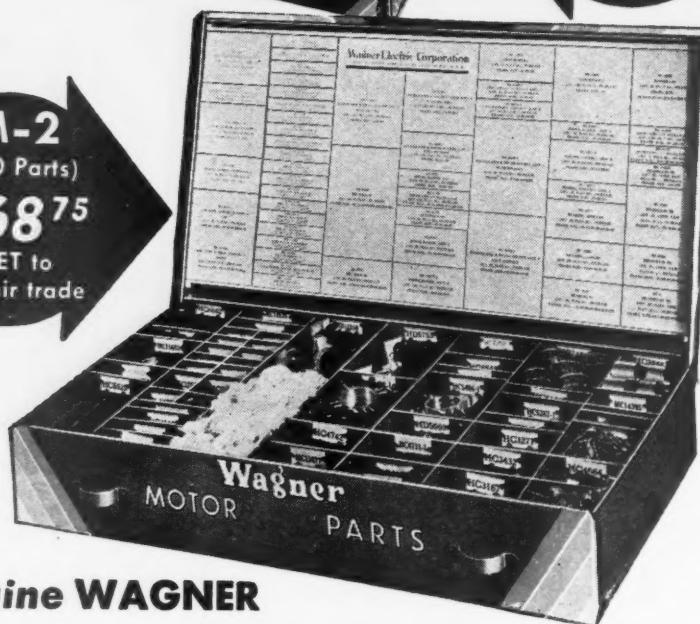
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M47-21

Wagner WE Electric

A. TO QUESTION 254—A single value capacitor motor is also known as a permanent split phase motor and is designed for use where the load is constant such as for fans and blowers. This type of motor has a low starting torque at best. It is evident that at some time the auxiliary winding has been replaced with a different size wire altering the resistance of this circuit and reducing the starting torque. It might be advisable to check the windings for any possible shorts and to make sure that the rotor is free to turn in the stator.

If these check ok., use an ammeter on the auxiliary circuit and take this amount of current in computing the size of the capacitor. The current consumption of the circuit should be approximately 1/4 of the full load-l amp.

$$MF = \frac{2650 \times 1}{330} = 8 + \text{which compares with the original size which should not differ from the one used by the manufacturer.}$$

The auxiliary circuit is permanently connected across the line in this type of motor and the voltage will reach 330, therefore, it is necessary for best results to use an oil-type capacitor rated at 330 volts.

Should the size of the capacitor differ after using the actual amount of current consumed by the starting circuit in the above formula, very likely a different size wire was used in rewinding. If the proper size capacitor does not give results, it is sometimes helpful to place the rotor in a lathe and turn a small amount of copper off the end rings in order to increase the resistance.—W.W.H.

A. TO QUESTION 254 — The starting torque of a single-phase induction motor is directly proportional to how closely one approximates two-phase conditions. However, the more displacement the current in the starting winding is given by increased reactance, the lesser is its value, so that the most practical condition is one where the magnetic field of the two windings is nearly circular and least elliptical. This is why the motor in question has little torque with the condenser having 400-450 M.F.D., since the displacement approached 90°, the current is so very small as to produce little flux.

It has been my experience that when replacing parts on machinery, they should be replaced with as nearly identical parts as possible, since these parts were designed to operate effectively and efficiently.

This condition of a split-phase induction motor failing to start on a certain position is usually the fact that

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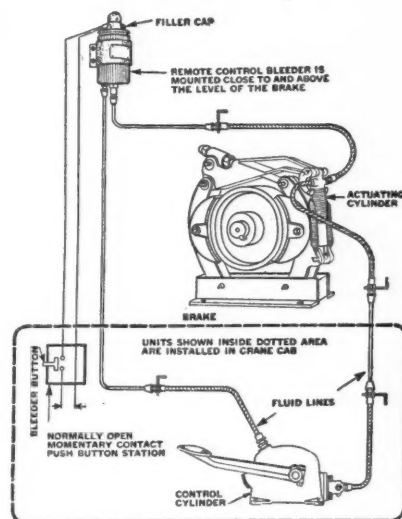
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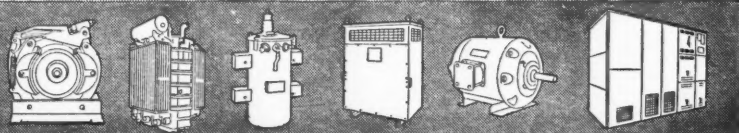
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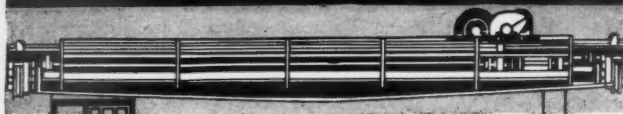
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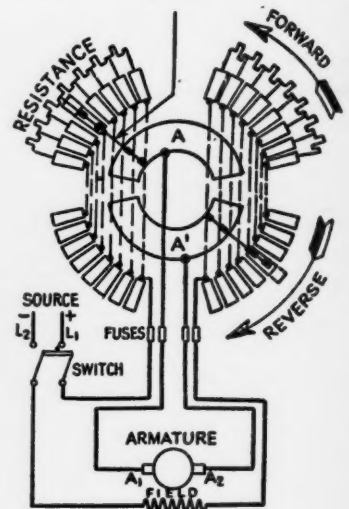
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some mechanical defect does not permit the starting switch to close. It may either be a worn spacer washer letting the rotor move away from the switch, thus not closing it, failure of the centrifugal device to close the switch, or a defective switch itself.—G.J.J.

Can you ANSWER these QUESTIONS?

QUESTION T11—In regard to single phase capacitor start split phase fractional hp. motors, will some one please explain how to figure needed capacity in microfarads? Example: In case a motor comes in for repair minus capacitor, what is the best method for obtaining correct capacitor? Is there some instrument obtainable for this purpose?—J.D.B.

QUESTION V11—The diagram below is of the conventional dial type d-c unit of somewhat bygone days. The resistance coils of the particular unit are located in the cast iron base and in spite of the perforated metal en-



sure, the heat becomes serious in summer time operation. Not only is the crane cab almost untenable, but the excessive heat is injurious to the resistor element and the insulation.

I would like to know if any readers have succeeded in substituting cast iron grid resistors, located at some remote distance, or have acquired the knack of brazing the element when breakage occurs.—P.C.Z.

QUESTION W11—What procedure is used in predetermining the increased losses due to increasing the length of the air gap on single and three-phase induction motors? Can these losses be compensated for in an eventual rewind?—T.B.B.

PLEASE SEND IN YOUR ANSWERS BY SEPTEMBER 15

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Questions on the Code

AVA Wire for Branch Circuits

Q. *Could No. 14 type AVA wire be used in conduit for a branch lighting circuit and fused at 30 amps. which table No. 1 of the 1947 Code states is its carrying capacity?—F.R.B.*

A. No. 14 AVA wire certainly could be used for a branch lighting circuit and being a permanent type of insulation which would not deteriorate with age, could be highly recommended (if cost and timing in obtaining it were not important). But such a branch lighting circuit in a dwelling could not be fused at over 15 amps. if supplying medium base lamp-holders, nor over 20 amps. if supplying heavy duty (Mogul) lamp-holders, except when supplying a single lighting unit and never at 30 amps.

No particular advantage is gained in using a wire of higher carrying capacity except one of larger size to lower the voltage drop as the fuse size must be kept down by the branch circuit rules.—F.N.M.S.

Cove Lighting

Q. *I have been asked to O.K. the installation of Neon cove lighting for a new home being built in this city. The contractor plans to use 12,000 volt Neon sign transformers and has agreed to enclose them in ventilated metal cases that will be accessible. Will such an installation be permitted by the new Code?—I.R.W.*

A. No, Section 4183 limits the open circuit voltage within dwelling occupancies to 1000 volts. This section also states that equipment having an open circuit voltage of more than 300 volts shall not be installed in dwelling occupancies unless such equipment is so designed that there shall be no exposed live parts when

lamps are being inserted, are in place, or are being removed. In other words, this prohibits the installation of ordinary Neon tubing within dwellings and requires the use of specially designed fixtures if electric discharge lighting systems employing 1000 volts or less are installed.—G.R.

Overcurrent Running Protection

Q. *On a thermostatically controlled motor of 1/20 hp., which operates the blower on an oil burning water heater, is it necessary to provide a manually operable disconnect, and must such a motor be equipped with some form of running protection. —R.A.C.*

A. A fixed motor of 1/8 hp. or smaller rating may depend upon the branch circuit overcurrent device as a connecting means. See Section 4402-a. This probably is not practical or convenient but it is permissible. Such a motor must be equipped with some approved type of running protection unless the impedance of the windings is sufficient to prevent overheating due to failure to start. If the impedance will prevent overheating, an automatically controlled fixed motor may be protected as specified in Section 4322-b for manually started motors. This section states that the branch circuit overcurrent device may be considered as providing the overcurrent running protection.—G.R.

Varnished Cambric Wire

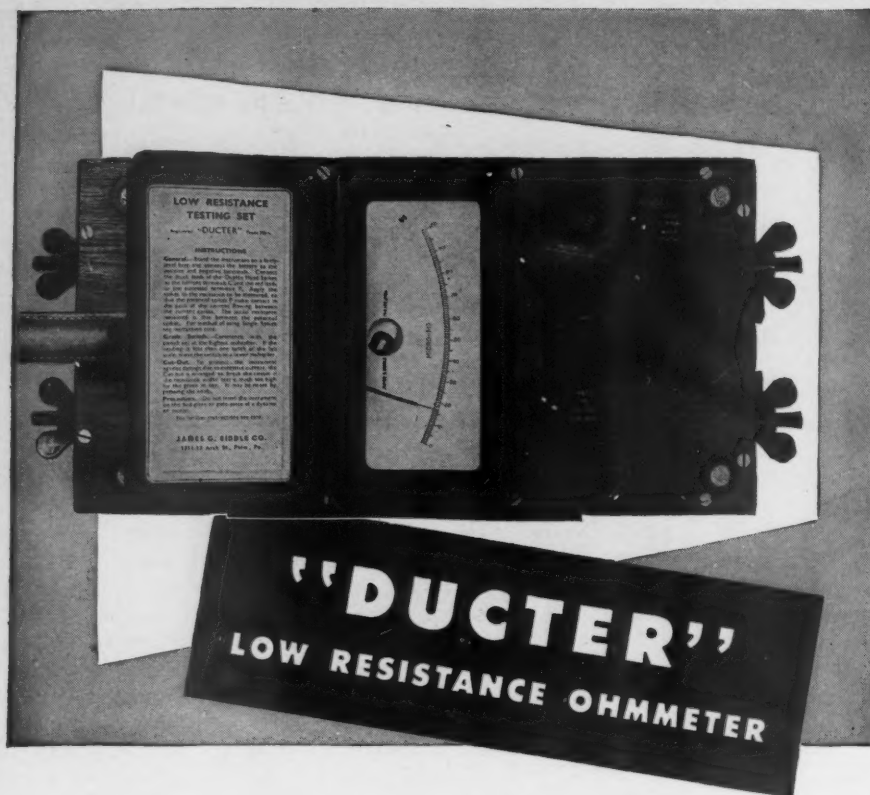
Q. *Can Type V wire be used in conduit, concealed knob and tube, or for open wiring?—F.B.*

A. Type V wire may be used for open wiring, conduit work or concealed knob and tube work in sizes larger than No. 6. This type of wire may be used in smaller sizes only by special permission. Of course concealed knob and tube work, when used, is generally employed as a wiring method for frame dwellings and as such only No. 14 or No. 12 circuit wiring is used; therefore there is probably very little use for Type V wiring in this method. With open work, there is considerable use as very often the larger size of Type V wires are used as feeders. With conduit, there is quite general use.—F.N.M.S.

Aluminum Conductors

Q. *I have installed a new feeder circuit to supply a combined motor and lighting load and have used type RH aluminum wire as the salesman suggested. Now the inspector has refused to O.K. the job claiming the voltage drop to be excessive. If type RH aluminum wire is not capable of carrying the same amount of current as a type R copper wire, why doesn't the Code make some provision for this?—M.L.L.*

A. The Code when written did not contemplate present copper conditions or it would no doubt have contained much more information concerning the use of aluminum conductors. However, if you will refer to Section 2202, you will note that voltage drop on feeders supplying combined loads is limited to 1 percent. Most wire mills supplying aluminum conductors are also furnishing engineering data concerning voltage drop, carrying capacity, tensile strength, etc. They are also claiming that a type RH aluminum insulated conductor will carry as much current as a type R insulated copper conductor of equal CM

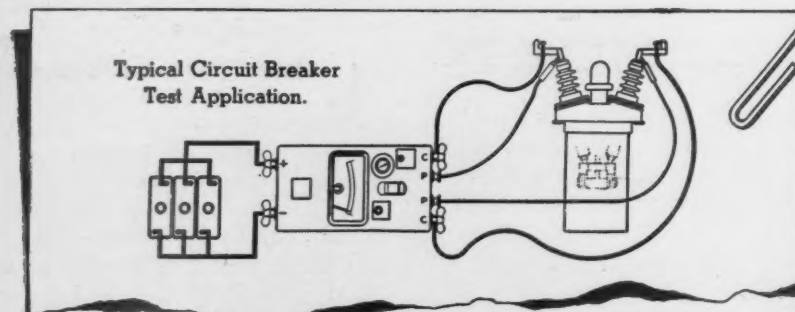


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area. This statement is correct, but it is apparent that you have become confused and have assumed that this also had reference to equal voltage drop. Current carrying capacity as limited by tables No. 1 and 2 of the Code is based on the amount of current that can be carried without overheating the insulation, and under Note 1 following Table No. 2 you will note that aluminum conductors have carrying capacities equal to 84 percent that of copper conductors of the same size. Upon referring to a handbook or the data supplied by the manufacturers, you will find that voltage drop on aluminum is greater and must be based on a ratio of approximately .64 to 1, when compared with copper. A simple method to follow is to use a conductor two sizes larger than the copper necessary to perform the desired job whenever the run is of any length making it necessary to consider voltage drop. —G.R.

Underground Cable

Q. We are about to do some trenchlay work underground. Can you give the Code ruling on this? —J.K.

A. Trenchlay cable is known generally under the Code as underground service entrance cable. Underground service entrance cable, type USE, and some makes of type ASE cable (when so marked on the tag) are approved for use underground; that is buried directly in the ground. There is no given depth to which it must be buried. Where the cable leaves the ground and goes up a pole or side of a house it may or may not need protection against mechanical injury depending upon conditions. Type USE cable must not be left exposed to the sun. —F.N.M.S.

Arc Welders

Q. Quite a few farmers are buying the transformer type arc welders on our project. Most of these have a maximum primary rating of about 37 amperes at 220 volts. We have been using 50 ampere breakers for service switches and the wiremen want to use these breakers as disconnect switches for these welders and in some cases they wish to mount a

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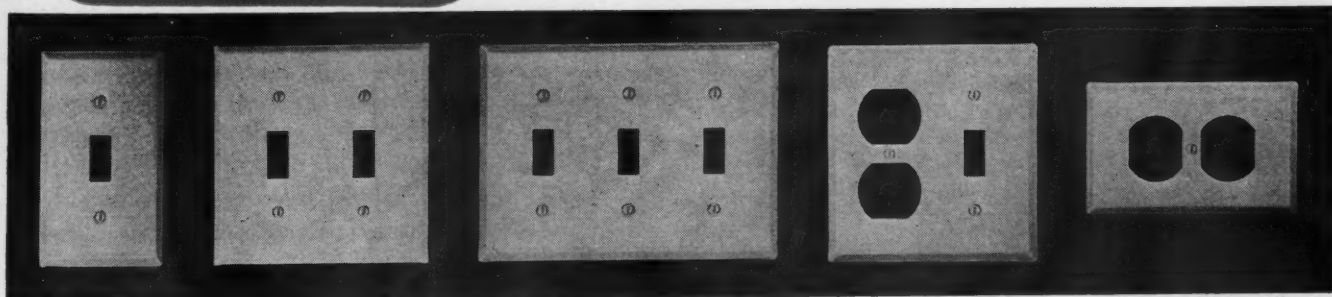
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receptacle on the yard light pole just below the meter loop equipment and use the service breaker as the disconnecting switch. Will the Code permit such installations?—A.P.

A. If the welder is equipped with a suitable control switch, the 50 ampere breaker may be used as the disconnecting means. However, I believe that in many cases the welders are not equipped with control switches and the disconnecting breaker becomes the only means of control. If this is the case, the 50 ampere breaker is not suitable as it will not conform to the requirements of Section 6313 which requires the control switch to be motor rated. The control switch suitable for a welder of this type is determined by the formula shown in Section 6313. —G.R.

Service Drop Conductors

Q. Is it still necessary to remove one-half inch of insulation from the drop loop of service entrance conductors whenever the rack is at the same level or higher than the pothead?—J.N.A.

A. No, this requirement is no longer part of the Code. Section 2337 now requires that the service drop conductors be attached to the service entrance conductors at some point lower than the pothead or the termination of the service entrance cable sheath. In other words, connectors should be used where we used to remove the insulation and they will also stop the siphoning of water through the small openings within the insulating jacket into the service equipment even though they are taped. —G.R.

Office Building Lighting

Q. Sometime ago we wired an office building and used No. 12 conductors for all lighting circuits. Now we wish to increase the illumination level and want to use 4 lamp 40 watt fluorescent fixtures. Will it be O.K. to increase the fuse rating from 15 to 20 amperes on these original circuits as we plan to place duplex convenience receptacles in each existing outlet and serve two of these fixtures from each outlet?—L.E.B.

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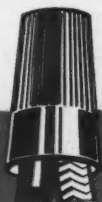
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A. The Code will permit the use of 20 ampere overcurrent protective devices on these No. 12 circuit conductors provided they supply only fixed fluorescent fixtures. This permission will be found under Section 2123. The exception shown under C-2 of this section reads as follows: "Medium based lampholders of the porcelain type and lampholders for fluorescent lamps may be connected to 20 ampere branch circuits if only fixed lighting units are supplied." A following fine print note defines a fixed lighting unit as one intended to remain in a fixed position even though connected through receptacles provided to facilitate servicing and replacement. You should also refer to Section 4125 of the Code before supplying two fixtures from a single outlet as this section requires that cord connected fixtures be suspended directly below the outlet box.—G.R.

Overcurrent Protection

Q. One of our contractors has installed a 400 ampere panel in an industrial plant and wants to supply a number of lighting circuits from the neutral and one of the phase conductors with the circuit control switches in this panel. May I require overcurrent protection between these switches and the main before approving the installation?—K. S.

A. If the switches controlling the circuits are rated at 30 amperes or less the Code will require overcurrent protection ahead of the switches, that is not in excess of 200 amperes. This may be found in Section 3882.—G.R.

Is A Gas Station Hazardous?

Q. Would a gasoline station be considered a Class 1 hazardous location?—F.R.B.

A. Sections 5141, 5142 and 5143 of the 1947 Code deals with gasoline stations.

In these Sections we find that in lubricating and repair rooms of a gasoline station the space below 4 ft. above the floor is considered a hazardous location and is to be treated under Class 1, Division 2, of Art. 500.

All wiring and equipment within five feet of the grade of a dispensing island or pump, must comply with Class 1, Division 2 rule, unless located at least 20 ft. away.—F.N.M.S.

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Modern Lighting

Light Setting For Jewelry



Jewelry section of Abelson's modern store is illuminated by cold cathode wall and ceiling cove lighting, fluorescent lamps mounted above recessed wall cases and PAR-38s over outer edges of glass-topped display counters.



Downlights above outer edges of glass counter tops are tilted away from aisles at 5-degree angle to prevent reflected glare reaching eyes of customers. Flat circular domes are cold cathode cove lighted. Recessed eggcrate fluorescent fixtures are used as separate units and also in combination with incandescent spot lights.

Progressive lighting applications and smart architectural designs blend to create an effective setting for the rich assortment of gems, precious metals and fine china in the eye-catching show windows and display cases of Abelson Jewelers, Newark, New Jersey. From the imposing street front facade to the extreme rear of the 175-foot deep main floor area, the related functions of merchandising, examination, adjustment, repair and service are carried on under glare free illumination provided by a modern multi source and multi treatment lighting plan.

Although the store is relatively narrow (measuring 26 feet along the front building line and less than 50 feet across the widest section), apparent spaciousness is achieved through the liberal use of mirrors, recessed wall cases, stepped series of lighted coves and transverse runs of recessed fluorescents. Illumination intensities throughout the store interior range from a restful 12 to 15 footcandles over central aisles to better than 65 footcandles over diamond displays. Intensities are selected in other areas to best present silver mellowness, glassware sparkle, china sheen and leather richness.

Six show windows, cantilevered from bulkheads of red brown precast granite and grey structural glass, are overhead lighted through clear glass tops by ceiling recessed PAR-38's on 16-inch centers. Additional Birdseye spotlights and standard incandescents in silvered reflectors are recessed into window ceilings to further highlight the displays. Alternate lamps are connected to separate circuits for flexibility of control.

Immediately inside the Herculite all-glass doors, three flat ceiling domes are cove lighted by single rings of cold cathode tubing. This ceiling treatment is repeated further back in the store opposite the repair service department. Between these points, the jewelry department receives general illumination from twin cold cathode runs in horizontal wall mounted and

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Color harmony is apparent in all areas. Illumination combines 3500-degree white fluorescent with warm incandescence. Woodwork is natural mahogany. Flooring is a combination of terra cotta asphalt and blue grey rubber tiling. Forest green, salmon, yellow and grey are prevalent in wall treatments, furniture fabrics and accessories.

stepped ceiling parallel coves. Over the central diamond counters, 150-watt PAR-38's are recessed and louvered while similar units are spaced on 3.5 foot centers above the outer edges of side wall jewelry counters. To eliminate the possibility of down light reflecting from glass counter tops to the eyes of customers, these PAR units are inclined at a 5-degree angle so that rays are directed away from main aisles. Recessed wall cases in this area are top lighted by separately switched 3500-degree white fluorescent lamps.

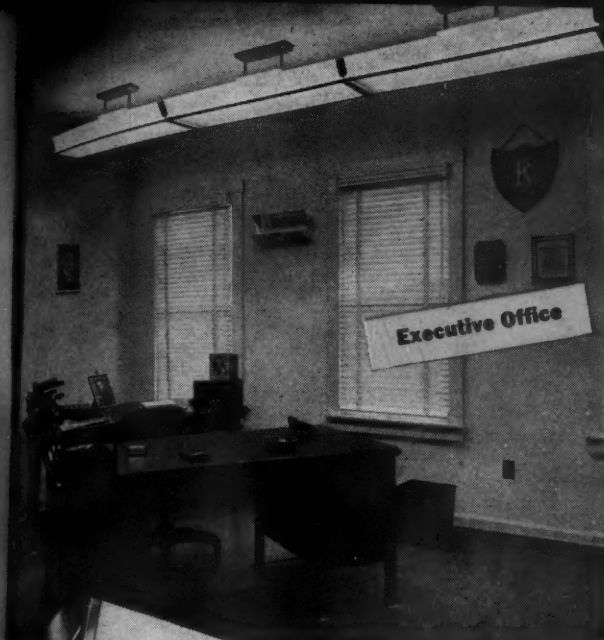
To the rear of the jewelry display section, separate areas are devoted to silverware, china, electrical appliances and radios. An optical department and cashier's cage are also accessible to the public. Through these areas, cold cathode cove lighting directs light upwards to relieve contrasts between ceiling surfaces and the visible light patterns created by combinations of recessed four lamp eggcrate louvered fluorescent fixtures, Birdseye spots and lensed incandescent units. In each four lamp fluorescent fixture, the two center and two outer lamps are separately switched to permit alternate use of all lamps when full lighting intensities are not required from the units. The fixtures are installed as individual units and are also used in combination with square lensed incandescent units. Wall cases, niches and special displays are illuminated by strip fluorescent runs and locally mounted spots.

The operation and layout of the entire store is on a departmentalized basis for maximum convenience and

service to customers. Stock is separated as to jewelry (rings, watches), tableware (silver, china) or accessories (radios, luggage). Jewelry designed for men is separate from that for women. Areas for selling are distinct from areas for service, adjustment and repair. Customers waste little time in shopping, completing a search for a specific item in a single department. This plan is carried out not only within the store but into sectional show windows and newspaper advertising, a single type of merchandise being stressed in each instance. Lighting and architectural design continue this approach by varying the types of fixtures, cases and physical layout of each department. The result is a pleasant variety of treatments that are cleverly distinctive yet related to an overall homogeneous plan. Color is also used to define departments by varying the shades and tints of the central color scheme of grey, salmon, forest green and yellow. Woodwork is natural mahogany and flooring combines blue and grey rubber tile with terra cotta asphalt blocks.

The completed project harmoniously combines clean designing, good engineering, excellent lighting and sound construction.

The entire design of the Abelson store was created by architects Telchin and Campanella in conjunction with Wilbur Johansen. Carl Schultz was the electrical contractor for the project. Lighting fixtures are by the Gotham Lighting Corporation and cold cathode installations are by the Boomsa Company.

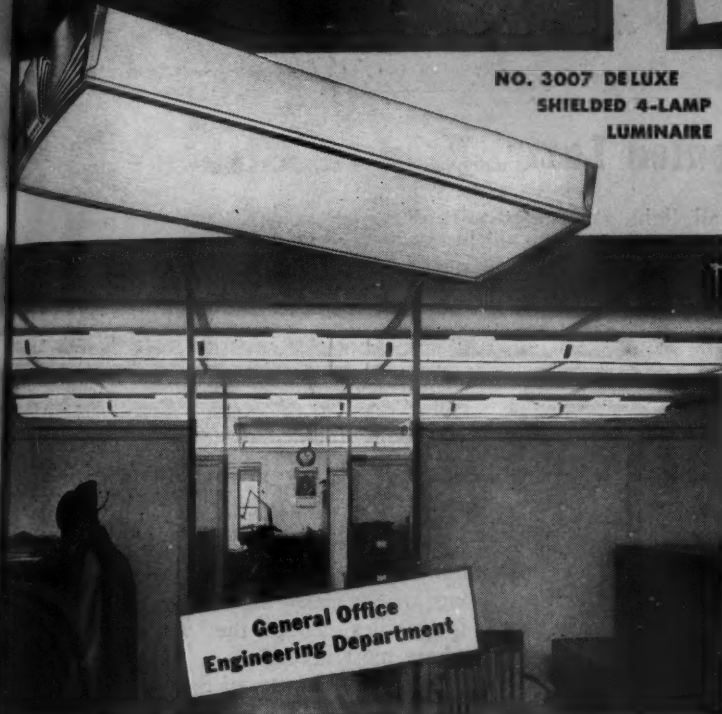


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"We have found that *the efficiency of our office personnel has very definitely increased*. Our employees are very happy with this new lighting. This is especially true in our General Office Engineering Department. We no longer hear rumblings of eyestrain and poor lighting. The same holds true at our Clinton, Mo., and Boonville, Mo. offices where we used 32 and 28 of your No. 3011 units respectively. Here, we also obtained 70 to 100 footcandles. THE LIGHTING

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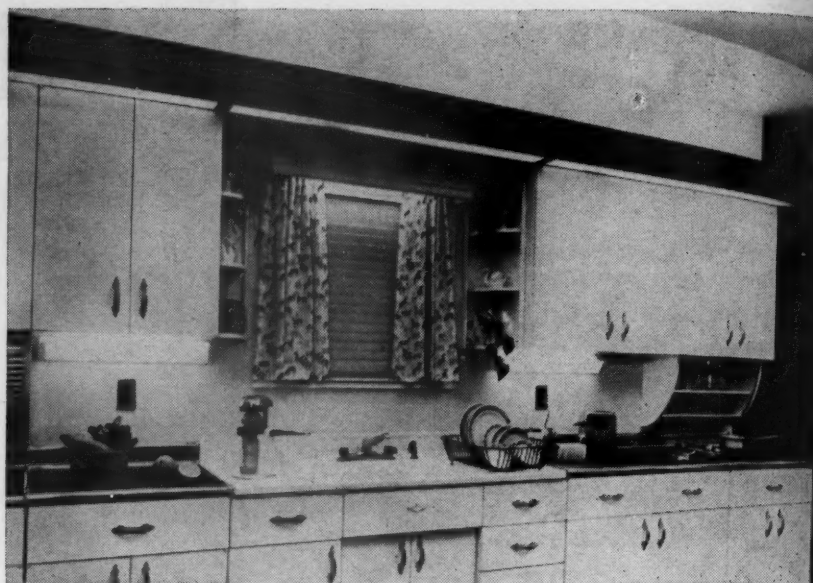
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By concealing all light sources in the kitchen, appearance of the room is improved, greater diffusion of light results, shadows are softened or eliminated, and glare and specular reflection are reduced to a minimum. Weiss and Besserman Company of Youngstown, Ohio, have installed such lighting in their kitchen show rooms, with excellent results.

The lighting consists of a combination of overhead lighting, which follows the work surfaces, and local lighting beneath the cabinets. The overhead lighting uses a continuous row of three 40-watt lamps and one 20-watt lamp concealed in a wooden shelf which forms a cover over the cabinets. Strips of glass are set in a groove of this shelf, so that both direct and indirect lighting are obtained.

Additional light is provided over the sink area by concealing a 30-watt fluorescent lamp in the window valance. The areas under the cabinets on each side of the sink are lighted by two units, one on each side, which use a 20-watt fluorescent lamp shielded with ribbed glass to prevent the bare lamps from being seen from the opposite side of the room.

The overhead unit provides 35 footcandles of illumination average, and the under cabinet brackets and valance light add another 25 footcandles, giving an unusually high intensity of 60 footcandles along the work areas, where most needed.

William Mistreta, of Sylvania Electric Products, Inc. designed this lighting system, using Sylvania fixtures and lamps.

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SPECIFICATIONS

Cat. No.	Stem Diam.	Stem Length
41	7/16	3/16
41PL	7/16	3/16
41B	7/16	7/32
41BPL	7/16	7/32
42	7/16	3/8
42B	7/16	13/32
43	7/16	3/4

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Electrical Division
VALPARAISO, INDIANA

Modern Lighting For Rural Schools

By **ROBERT G. CASS,**
Lighting Engineer, New Jersey Power and
Light Company.

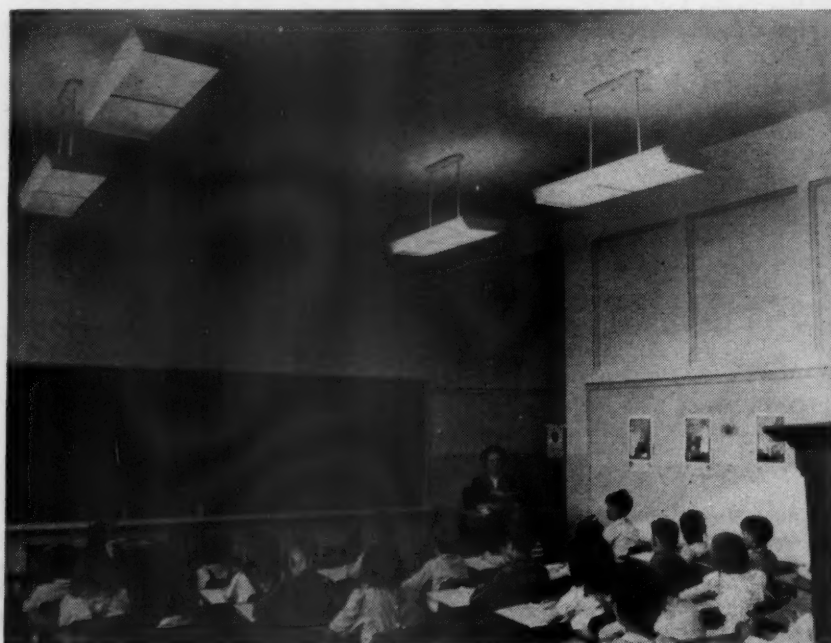
In many of our smaller communities, Boards of Education are often limited, in their desire to improve teaching conditions, by insufficient funds, lack of knowledge of new products or techniques and the prevalent nostalgia on the part of many adults for existing conditions which are pleasantly associated with memories of their own schooldays. It is frequently a moot question as to how far the responsibility of the lighting engineer extends in assisting local school boards to relight their buildings. It is our policy, when called upon for lighting recommendations, to include suggestions for general modernization. These suggestions pertain to painting, structural alterations, altered seating arrangements and use of natural light to augment the proposed modern lighting plan.

Two classrooms of a grade school in Lambertville, New Jersey, are examples where definite improvements were achieved without appropriating prohibitive budgets. The two existing, suspended, luminous globe fixtures were so inadequate that little difference in lighting levels could be detected, during daylight hours, between the artificially lighted and unlighted conditions. Levels ran from highs of 8-12 footcandles on desk tops nearest

the windows to lows of 2-5 footcandles along the inner walls. Large black-board areas, seldom used, absorbed a major portion of the light striking these surfaces and dark woodwork also contributed to a low reflective factor.

Following our recommendations, the Lambertville Board of Education proceeded with a relative modernization program, voting that the side and rear blackboards be replaced by light tackboards; the several small front blackboards be replaced by a larger, continuous one; the ceiling-hugging windows between rooms and interior corridors be covered with plywood panels; the inadequate incandescent fixtures be replaced by six four-lamp, 40-watt, shielded, suspended Westinghouse fluorescent luminaires; and the color scheme be altered. The colors recommended were matte white for the ceiling, honey yellow for side walls down to a dado, light rust or mauve for wainscote.

Light meter readings after 80 hours of use ran from 40 footcandles at the inside walls to 60-80 footcandles on desk tops adjacent to the windows. Teachers in both classrooms voluntarily noted that, with the brighter surroundings, pupil concentration was greater, it was easier to hold the attention of the children, the students seemed not to tire as readily and lessons were grasped more quickly and more thoroughly. With this visual indication of better lighting for the pupils, the Board considering a progressive plan for duplicating the treatment in their entire school system.



Rural schoolroom is modernized on a limited budget by installing four-lamp fluorescent shielded units to replace two existing luminous globe suspended fixtures, replacing sidewall blackboards by light tackboards and painting ceiling and walls with scientifically selected colors having high reflective factors.

In the News

Most Construction May Be Intrastate

One of the many new problems bothering members of the National Labor Relations Board is application of the Taft-Hartley Labor Law to the construction industry.

This will be one of the first pieces of business taken up when the two additional members of the Board are confirmed and take their places alongside the three "old" members.

Most of this industry, which includes the electrical construction industry, is not engaged in interstate commerce and, thus, is exempt from the new federal law. For that reason NLRB has up to now declined to exercise its jurisdiction over the construction industry. It is doubtful that NLRB can continue this position.

Because of the emphasis the new law places on banning three practices prevalent in construction—the closed shop, boycotts, and jurisdictional strikes—NLRB knows it can no longer ignore this industry.

It will have to take jurisdiction, and in doing so will stir up considerable opposition from the A.F.L. building trades unions, which declare they will fight the issue in the courts.

Once NLRB has made its processes available to this industry, the next fight will be on deciding precisely what construction is intrastate (exempt) and what is interstate (covered).

While this issue, too, may require a court decision, off-the-cuff opinion is that the boycott of materials which cross state lines comes under the definition of interstate commerce.

Actual construction activity presents a different problem. Senator Robert A. Taft, co-author of the law, has admitted that much of it is intrastate. What is interstate? Construction of highways, railroads and factories clearly appear to be interstate. Home building probably would not be.

As a precautionary measure, the A.F.L. building trades executive council has decided not to make any more jurisdictional decisions involving its affiliated unions until the question has been clarified. It is to consider the matter again at a meeting September 3 in Chicago.

IBEW Reorganization

The International Brotherhood of Electrical Workers is reorganizing its four branches of jurisdiction in the electrical industry into five branches.

This action, recommended by a committee authorized at the San Francisco convention last September and approved by the IBEW international executive council, is being voted on by the 350,000 members in a referendum to be completed July 31. (The convention also created a new classification of "BA" locals whose members have equal voting rights with "A" locals but do not participate in pension and death benefits.)

The jurisdiction committee was appointed to iron out jurisdictional differences which have arisen between inside electrical workers, outside electrical workers and those employed by utilities. Representatives from the three groups comprised the committee.

The proposed constitutional amendments would organize IBEW members under five branches:

1. Outside and utility workers.
2. Inside electrical workers.

3. Communications, voice, sound and vision transmission and transfer-ence employees.

4. Railroad electrical workers.

5. Electrical manufacturing employees.

The electrical manufacturing branch is a new one. Outside workers' branch was enlarged to include utility workers. Communications was added to the No. 3 branch.

Besides "outside" workers previously covered, the "outside and utility workers" branch will include all employees of electric generating or distributing companies and have jurisdiction over the operation, repair and maintenance of their equipment and most electrical construction work outside of isolated plants.

The new jurisdictional boundaries will apply to the future, the committee stating it had no intention of upsetting existing arrangements.

The committee admitted that its recommendations would not end all jurisdictional differences, but believes that "its efforts to simplify and clarify will materially reduce misunderstandings and differences."

Daniel W. Tracy, international president, will continue to decide ap-



"George is hoping those drying lamps will take care of that spot in the middle of his back he can't reach with the towel."

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peals on jurisdictional questions under a section of the constitution which states that, when disputes arise, he should determine what local union will do the work "consistent with the progress and best interests of the IBEW in obtaining and controlling the work in question."

Production Problems Will Be Discussed At NECA Meeting

Present costs of electrical construction will be reviewed at the annual meeting of the National Electrical Contractors Association in San Francisco September 8, 9 and 10, NECA officials announced in Washington this week.

The forum-type meeting will be devoted largely to a critical analysis of all elements of productivity related to electrical construction, repair and maintenance, with the objective of determining what steps may be taken to lower present costs, according to Robert W. McChesney, president of the association.

Representatives of the electrical manufacturing industry, electrical wholesalers, the utilities, labor and contractors will report on the effects in their fields of present levels of costs and productivity.

"The important problem facing our industry," McChesney asserted, "is to increase productivity. That is a job that must be shared jointly and



An active part in the sessions of the New York State Association of Electrical Contractors and Dealers, Inc. at Saranac Inn was taken by A. A. A. Tuna, Tuna Electrical Co., N. Y.; R. W. Mitchell, Whipperman & Mitchell, Inc., Buffalo; L. W. Kiesewetter, Syracuse; and W. T. Langdon, Langdon and Hughes Construction Company, Utica.

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Herb Metz, district manager, Graybar Electric Co., Inc., New York and Maynard H. Salmon, president, Salmon Electric Co., Syracuse, did a bit of relaxing during the annual convention of the New York State Association of Electrical Contractors & Dealers, Inc. at Saranac Inn.

realistically by both labor and management. Wages in our industry are high and that calls for high output per man-hour to justify them. Management must be extremely alert and ingenious in method and equipment to keep the productivity level high so that all three partners in our economy, our customers, our workers and our management, get a fair share."

He expressed a conviction that the meeting would result in the formulation of "definite plans" for increasing productivity in the contracting industry.

REA and A T & T Agreement

Details of the long-expected agreement for joint use of facilities between the Rural Electrification Administration and the American Telephone and Telegraph Co. were announced recently. The agreement was in the form of two "standard contracts," whereunder an REA borrower and a Bell System company could arrange to lease either power or telephone lines and poles for combined service.

The lending agency long has cherished an interest in telephone operations. Until recently, at least, it has supported proposed legislation which would authorize REA to make loans for rural telephone service. Two such bills still are before the Congress, one sponsored by Sen. Lister Hill of Alabama and the other by Rep. Will

Poage of Texas, ardent Congressional adherents of REA.

The agreement with AT&T provides the basis for contracts with either Bell companies or independent telephone systems and specifies that rural electric cooperatives will not render telephone service under such arrangements. But REA officials indicated that they still have a hopeful eye on the Hill-Poage bills.

For example, REA Administrator Claude Wickard pointed out that the new point-use agreement, while making possible "certain economies in the construction of rural power and telephone lines," might mean little to rural people, of whom "only about 40 percent have telephone service."

"In some cases," he added, "telephone companies still may not find rural lines sufficiently profitable to interest them, even taking into account the economies resulting from joint-use agreements. Also, telephone companies such as small independents and mutuals may not be in financial position to participate in a program of this type. In other words, approval of these contracts, although helpful, does not in itself give definite assurance of telephone service to REA (power) consumers."

The contract for joint use of poles, likely to be more common than the sharing of actual lines, calls for payment by the telephone company to the REA system involved of an annual rental of \$1 to \$1.70 per pole, depending on sectional pole-line costs, when REA poles are used. When telephone poles are used, the REA borrower will pay 70 cents more per pole where the telephone company



M. J. "Mike" Boyle, vice-president, District Six, IBEW, expresses his confidence in continued labor-management cooperation in the electrical construction industry at the recent NECA Division Four meeting in Chicago.

**The SHAFT
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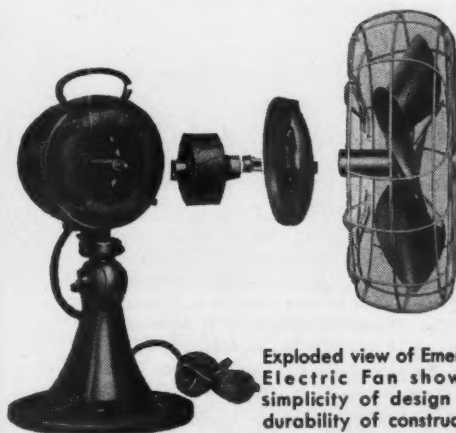
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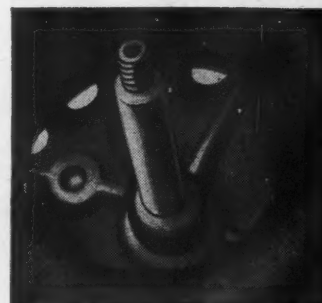
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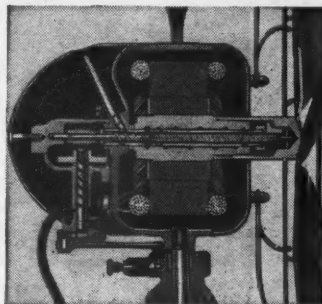
THE EMERSON ELECTRIC MANUFACTURING CO.
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Exploded view of Emerson-Electric Fan showing simplicity of design and durability of construction.



Case-hardened, hollow-steel shaft, on which the rotor revolves, is securely anchored in the motor frame.



Spiral oil grooves in the rotor core and the spiral oil conveyor attached to the floating worm shaft keep the oil circulating continuously, providing "forced feed" lubrication.

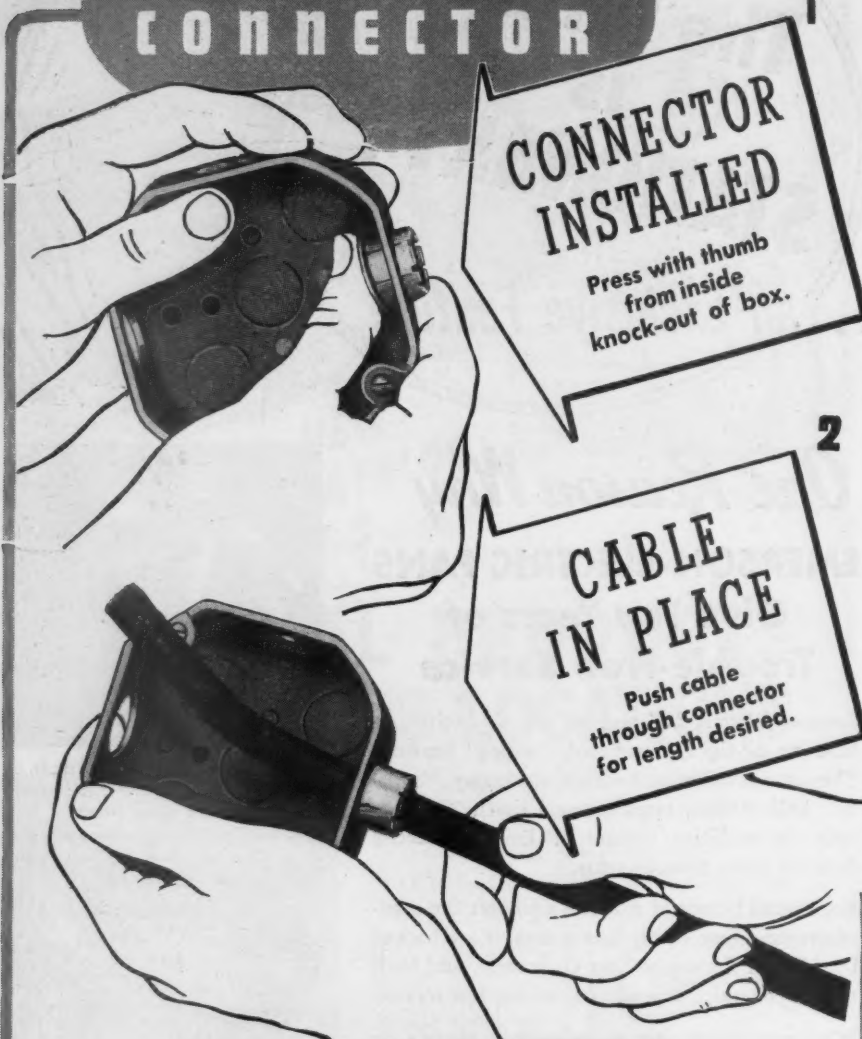


Finger-tip oscillation adjusting case. Simply turn the rim of the adjusting case to the desired range of oscillation, from 90° down to stationary position.

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William B. Terry Organizations, Inc.	618 W. 26th St., Kansas City 8, Mo.
NuRo Company	414 Houston Building, San Antonio, Texas
W. H. Berry, Jr.	88 Pryor Street, S. W., Atlanta 3, Georgia
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is required to install more expensive poles to carry power lines.

Rates are based on use of 35-foot Class 6 poles, which, it was agreed, are adequate to carry both telephone and power circuits. If either utility requires more expensive installations, it will bear the difference in installed cost between the necessary facilities and Class 6 poles. Telephone and power systems each will own and maintain their own property on the poles.

The form contract for joint use of wires covers so-called carrier telephone installations. This type of service has been adjudged both by the telephone industry and REA as likely to be limited to areas of very low consumer density. Only about 100 carrier telephones now are used in residential service.

REA power systems will be reimbursed by the telephone company installing carrier facilities for any expenses incurred because of the installation. In addition, the REA system will receive a rental fee of \$1 per year for each pole used.

R. W. Staud Elected President of IES

Rudolf W. Staud is the newly-elected President of the Illuminating Engineering Society. He will take office as the 43rd President upon the expiration of retiring President G. K. Hardacre's term on October 1, 1947.

President-elect Staud, of the Benjamin Electric Mfg. Co., Des Plaines, Illinois, is a well-known figure in the lighting industry. For many years, he has been actively identified in industry-wide activities relating to the improvement of practices and the development of higher uniform standards for lighting equipment. He has



R. W. STAUD

served the RLM Standards Institute (a national specification-certification activity in the industrial lighting equipment industry) as its President since 1936. He is a director of the Chicago Lighting Institute, and Vice-Chairman of the 2nd International Lighting Exposition and Conference which is to be held next November 3-7 in Chicago. He is a past president of the Porcelain Enamel Institute. Among the offices he has held in the Illuminating Engineering Society are those of Vice-President, Director, and Chairman of numerous committees. In the National Electrical Manufacturers Association, he has also held numerous chairmanships and served on many committees. He became associated with the Benjamin Electric Mfg. Co. in 1927. Today, he is manager of sales promotion and development, and editor of "The Lighting Review and Digest".

Milne Appointed Secretary of IBEW

New men stepped into two top positions in the hierarchy of the International Brotherhood of Electrical Workers, AFL, last month.

The veteran G. M. Bugnaziet, international secretary for 23 years, resigned to turn his tasks over to a younger man, J. Scott Milne, IBEW vice president on the West Coast.

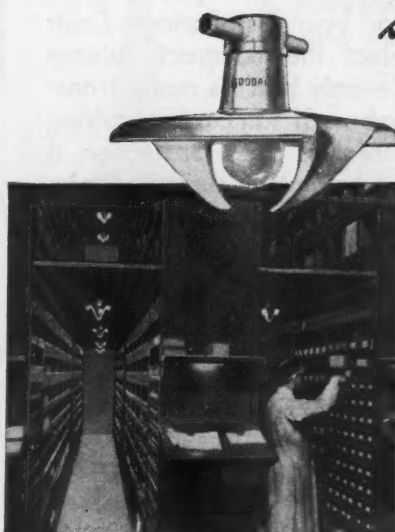
Louis Sherman, special assistant to Secretary of Labor Schwollenbach, was appointed IBEW general counsel by International President Dan W. Tracy. Mr. Sherman, who resigned from the Labor Dept. after eight years on the staff, will fill a post that has been vacant for several years.

Mr. Tracy accepted Mr. Bugnaziet's resignation "with regrets," but persuaded him to continue to serve the union as executive director of the National Electrical Benefit Fund recently established by the National Electrical Contractors Assn. and the IBEW.

Mr. Bugnaziet, who is also fourth vice president of the A.F.L., is 69 and has been a member of the IBEW 47 years. Before becoming secretary, he was vice president for 13 years and, for five years, business agent of Local 419 in New York.

Mr. Tracy appointed Mr. Milne to succeed Mr. Bugnaziet as IBEW secretary and also as secretary of the Electrical Workers Benefit Assn., which administers the union's insurance funds, another job which Mr. Bugnaziet relinquished.

Oscar Harbak of Seattle, an international representative, will fill Mr. Milne's post on the West Coast.



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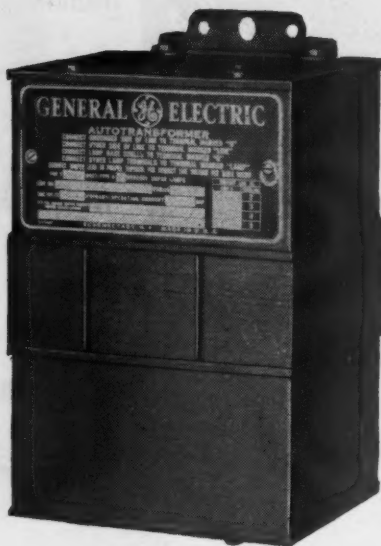
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General Electric Tulamp transformers are high-power-factor units, accurately designed to assure successful operation. Strong internal framework holds the core, coil, and housing firmly together, minimizing noise from vibration. Core surfaces are amply exposed to dissipate heat, prolonging transformer life. Large and roomy junction box, plus nine standard knockouts facilitate installation.

When you specify General Electric Mercury H lamps and G-E transformers, you get co-ordinated design—lamps and transformers built to work together. For further information, write Apparatus Dept., General Electric Co., Schenectady 5, N. Y.

GENERAL  ELECTRIC

412-23

Louis Sherman, special assistant to Secretary of Labor Schwollenbach, has resigned to become general counsel of the International Brotherhood of Electrical Workers, AFL.

He has been a member of the Dept. of Labor staff for eight years.

Conferences and Forums on Program of Lighting Exposition

First details of the 5-day program of lighting forums and conferences planned for the 2nd International Lighting Exposition to be held in Chicago on November 3-7 were released recently by the Exposition Operating Committee.

"Through a series of five morning conferences beginning November 3," Program Committee Chairman W. P. Lowell announces, "the Exposition will offer to all those interested in industrial and commercial lighting a program designed to help answer the question with which both user and seller are vitally concerned today: 'How to Plan Today for Tomorrow's Lighting'. The remarkable advancements in lighting equipment and in the science of seeing during the past few years are today evident as never before. So that American Industry and Business may capitalize on these advancements, the Planned Lighting Method is being initiated and sponsored by the Electrical Industry. Our conferences will seek to implement



S. J. O'Brien, (right) president of S. J. O'Brien Sales Corp., New York greeted N. J. MacDonald, vice president, Thomas & Betts Co., Inc. Elizabeth, N. J. just before Mr. MacDonald's address on interdependence at the annual convention of the New York State Association of Electrical Contractors & Dealers, Inc. at Saranac Inn.

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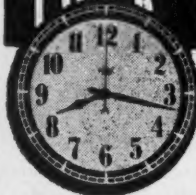
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For all types of electrical switching and time control; standard 24-hour models available for 110 or 220 volts, 60 c. A.C. Additional features such as Astronomic Dial, Weekly Calendar Wheel, additional "ON" and "OFF" operating arms, Selectors, Time Delay circuits, and other features are available to meet your requirements. Prices from \$13.00 list and up. We will be pleased to recommend the Tork Clock best suited to your needs.

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'SAFETY SET'
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No standing on chairs; electrosetting mechanism allows clock to be re-set easily from the floor. Reflectionless 14" dial; spun aluminum case, white, maroon and polished aluminum. Self-starting, 110 volts, 60 cycle A.C.

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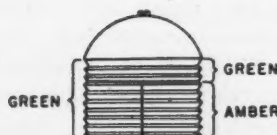
MOUNT VERNON NEW YORK

MORE THAN 80 DIFFERENT COLOR COMBINATIONS OF THIS NEW PATHFINDER LIGHT!

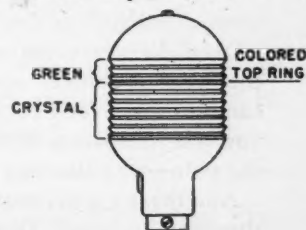


Left:
Pathfinder—
in garden of
"Past War
Home," Los
Angeles

DESIGNED for safety and convenience as well as ornamental effects, the Cannon Pathfinder Light, with its available combinations of colored lens, adjustable light spread, different heights, low voltage and high voltage types, is a multi-purpose unit for homes, grounds, institutions, hotels, parks, clubs. Use for lighting or marking steps, paths, roads, driveways, gardens, porches, runways of Class I and II airports, etc.



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this program with the know-how and facts essential to its fulfillment."

The program begins on Monday, November 3, at 10:30 AM, with a conference session devoted to the presentation and discussion of the winning entries in the Exposition sponsored Merit Award Competition on the subject; "What Planned Lighting Can Do". On the program will be the men who, by the excellence of their actual work in lighting, will bring authoritative proof of what can be done with modern lighting equipment, lamps and techniques.

Tuesday: "Trends and Progress in Lighting"

President-elect of the Illuminating Engineering Society, R. W. Staud, Benjamin Electric Manufacturing Co., is the chairman of the Tuesday forum, which begins at 9:30 AM, as do all subsequent sessions. "What's New in Lighting, and How to Utilize These Developments" is the subject of the three prominent men representing the Power Company, Engineering and Lighting Manufacturers' viewpoints. They are George Whitwell, Vice-President, Philadelphia Electric; H. E. Murphy, Stone & Webster Engineering Corp.; and D. G. Mitchell, President, Sylvania Electric Products, Inc.

Wednesday: "Industry Plans for Lighting Promotion"

Chairman of the Wednesday conference on "How to Make the Planned Lighting Program Work" is Merrill Skinner, Union Electric of Mo. Reports on how to organize a planned lighting program, how to obtain technical data, and how to do practical consumer planning will be presented by J. S. Schuchert, Mgr. Commercial Customer Dept., Duquesne Lighting Company; L. E. Taylor, Detroit Edison Co., and Sr. Vice-President, Illuminating Engineering Society; and Gilbert S. Underwood, Supervising Architect, Public Buildings Administration, U. S. Government. Also to be presented for discussion at this meeting are "NEMA Plans for Lighting Promotion" by E. C. Huerkamp, Sales Manager, Lighting Division, Westinghouse Electric Corp.

Thursday: "How the Electrical Wholesalers Can Increase His Lighting Sales"

Chairman of the Thursday Electrical Wholesaler conference session is C. G. Pyle, Managing Director, NEWA. Axel Kahn, District Manager, G. E. Supply Corp., H. P. Litchfield, Ass't. General Sales Mgr., Graybar Electric Co., J. M. McKibben, Ass't. to Vice President, Westinghouse Electric Corp., and another speaker to be announced later will present the latest developments in

OHIO Burnishing TOOLS

**GUARANTEE
GOOD MOTOR
HOUSEKEEPING**

**THEY KEEP
COMMUTATORS
"SPIC'N SPAN"**



During normal operation, under certain conditions and often caused by improper brush application, a high resistance film forms on commutation and ring surfaces. This film is detrimental to the efficient operation of motors and generators. OHIO Burnishing Tools remove this film and leave a commutator or ring surface clean and glass smooth. There is a style and size of tool for every purpose and for motors from flea to heavy duty horse power. Sold under guarantee of absolute satisfaction.

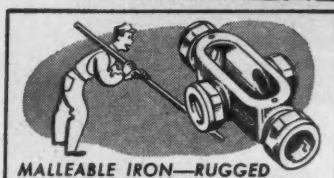
**THESE TOOLS ARE APPLIED
WHILE THE MOTOR
IS IN OPERATION**

BUY YOUR
CARBON BRUSHES
FROM A
SINGLE
SOURCE

**THE OHIO
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12508 BEREA ROAD
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They make
tough jobs easy
because
**GEDNEY
FITTINGS...FIT!**



MALLEABLE IRON—RUGGED



SMOOTH INSIDE AND OUT!



BRIGHT FINISH—RUST PROOF



THREADS CLEAN—EASY TURNING



EASY TO INSTALL



A COMPLETE LINE

**GOOD WIRING DEPENDS
ON FITTINGS THAT ARE RIGHT
FOR THE JOB!**

What electricians and contractors want most in the fittings they use is smooth fit. They want conduit to thread in smoothly, caps to fit into place easily, screws to align and tighten evenly. With GEDNEY fittings the contractor knows his job will come out right. All GEDNEY fittings are packed in sturdy, metal-edged boxes that can't break open, and each package is clearly labeled for quick selection.

The fact that GEDNEY fittings have been on the "best seller" list with mechanics who know fine accessories is proof enough of year in—year out excellence. Check the other features in the panel at left. They highlight the points about GEDNEY fittings that mean money in the bank for "live wire" wiring men.

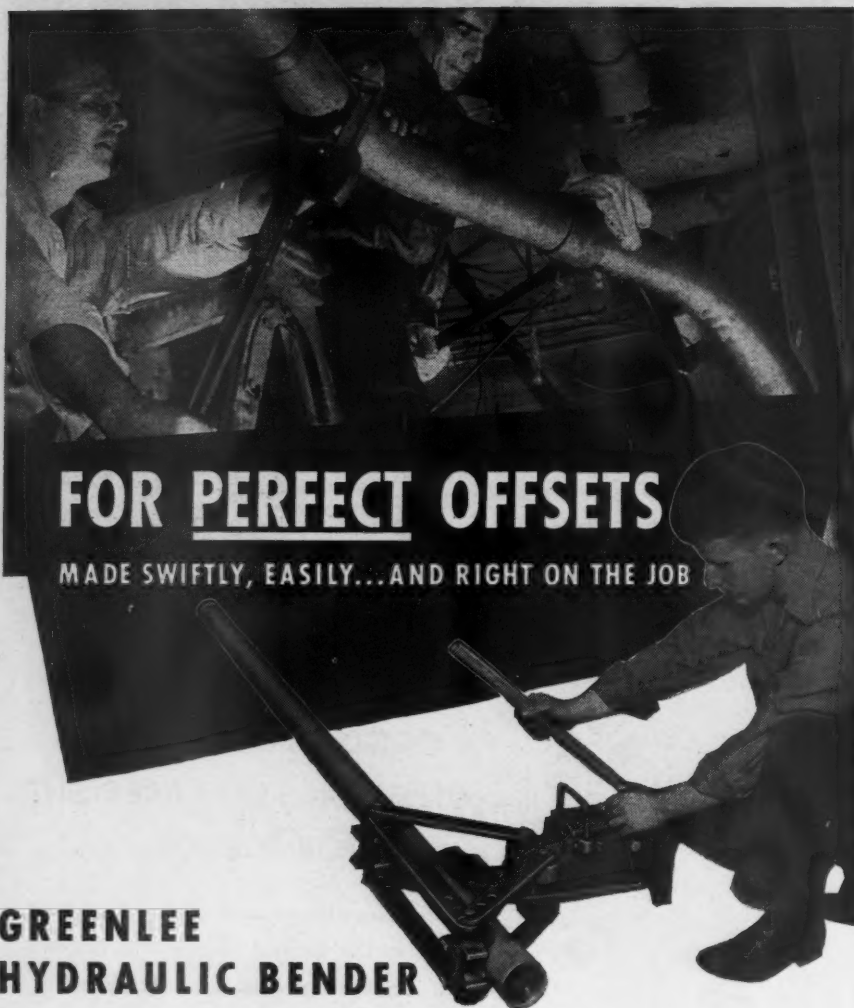
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WHOLESALE



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LITERATURE

GEDNEY ELECTRIC CO.

FOUNDRY, FACTORY & SHIPPING POINT: TERRYVILLE, CONN.
RKO BLDG., RADIO CITY, NEW YORK 20, N. Y.



GREENLEE HYDRAULIC BENDER

"Accuracy in offsetting is one of the big features we like in the GREENLEE Bender," reports Perry Electric Company of Hartford, Connecticut.

"On a sixty-foot tunnel job with a series of complicated bends, for example, we saved a lot of time with our GREENLEE. Compared with old methods of conduit bending and installation, the work goes six times faster," continues the report.

Let a GREENLEE make valuable time and material savings for you, too. *One man* operated to quickly produce

smooth, accurate bends in pipe up to 4½", rigid and *thin wall* conduit, tubing, bus-bars. Compact, portable, easily set up. Eliminates need for many fittings and the work of installing them. And, most important, helps produce jobs of fine appearance.

Whatever your bending job, there's a GREENLEE to do it. Get complete facts on GREENLEE Hydraulic and Hand Benders. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 1748 Columbia Avenue, Rockford, Ill.



OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pushers

marketing, planning and merchandising lighting equipment and training salesmen to properly present the Planned Lighting method.

Friday: "The Electrical Contractor, Key Man in the Lighting Plan"

W. T. Stuart, Editor of *Electrical Construction and Maintenance*, is Chairman of the final conference session. On the program are Electrical Contractors Leo Gamp, Gamp Electric Co., and Warren W. Langston, Jack Stone Electrical Co., and Ward Harrison, Mgr., Engineering Division, Lamp Department, General Electric Co., who will discuss Contractors' Selling Plans, Service Maintenance Plans that work, and how to "Light Beyond Tomorrow".

DATES AHEAD

American Institute of Electrical Engineers—Pacific General meeting, San Diego Hotel, San Diego, Calif., August 26-29.

Illuminating Engineering Society—Annual convention, New Orleans, La., September 5-10.

National Electrical Contractors Association—Annual meeting, Palace Hotel, San Francisco, Calif., September 8-10.

Illuminating Engineering Society—Technical Conference, Roosevelt Hotel, New Orleans, La., September 15-19.

International Association of Electrical Inspectors—Northwestern Section, Eugene Hotel, Eugene, Ore., Sept. 22-24; Southwestern Section, Mission Inn, Riverside, Calif., September 29-October 1; Western Section, Mount Royal Hotel, Montreal, Quebec, Canada, October 13-15; Eastern Section, Seaside Hotel, Atlantic City, N. J., October 20-22; Southern Section, Hotel George Washington, Jacksonville, Fla., October 27-29.

International Municipal Signal Association, Inc.—Annual meeting, Pantlind Hotel, Grand Rapids, Mich., September 29-October 2.

National Safety Congress & Exposition—Chicago, Ill., October 6-10.

First Annual Cold Cathode Fluorescent Lighting Exhibit—Hotel Commodore, New York, N. Y., October 7-9.

National Farm Electrification Conference—Claypool Hotel, Indianapolis, Ind., October 7-8.

International Association of Electrical Leagues—12th Annual Conference, Statler Hotel, St. Louis, Mo., Oct. 8-11.

American Standards Association—Annual meeting, Waldorf-Astoria Hotel, New York, N. Y., October 21-23.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., Week of Oct. 26.

National Electronic Conference—Edgewater Beach Hotel, Chicago, Ill., November 3-5.

American Institute of Electrical Engineers—Midwest meeting, Chicago, Ill., November 3-7.

2nd International Lighting Exposition—Hotel Stevens, Chicago, Ill., Nov. 3-7.

National Metal Trades Association—Palmer House, Chicago, Ill., November 6-17.

National Association of Manufacturers—Waldorf-Astoria Hotel, New York, N. Y., December 3-5.

Fifth All-Industry Refrigeration and Air Conditioning Exposition—Public Auditorium, Cleveland, Ohio, January 26-29.

American Institute of Electrical Engineers—Winter general meeting, William Penn Hotel, Pittsburgh, Pa., January 26-30.

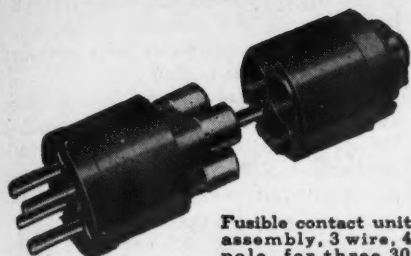
8th International Heating and Ventilating Exposition—Air Conditioning Exposition, Grand Central Palace, New York, N. Y., February 2-6.

National Electrical Manufacturers Association—Winter Convention, Edgewater Beach Hotel, Chicago, Ill., March 14-18.

Chamber of Commerce—Annual meeting, Washington, D. C., April 27-29.

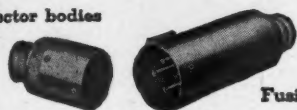
National Electrical Wholesalers Association—Annual convention, Statler Hotel, Buffalo, N. Y. First week in May.

FUSIBLE TRIPLOC plugs and receptacles



Fusible contact unit assembly, 3 wire, 4 pole, for three 30 amp. 250 v. cartridge fuses or fuse-trons. Also 2 wire, 3 pole (2 fuse) type for universal tools.

Connector bodies



Fusible plug

The use of fusible Triploc plugs on extension circuits will automatically isolate a defective tool or device without interrupting service to other equipment. This protection is especially valuable on production lines using numbers of portable tools. Triploc plugs and receptacles are heavy duty types to withstand hard use. The complete range of types includes fusible plugs, cable connectors, and receptacles in many housing types with conduit fitting bodies in standard styles and sizes. Consult your Pylet catalog for complete listings of all types.

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THE PYLE-NATIONAL COMPANY
1344 N. Kostner Avenue, Chicago 51, Illinois

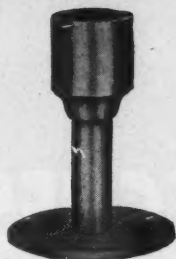
FULLMAN

Latrobe PRODUCTS

★ FLOOR BOXES ★



WIRING SPECIALTIES



No. 280 Nozzle with
No. 200 Cover Plate

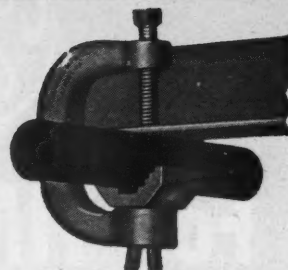
10 Amp. 250 Volt Receptacle in Brass Housing, mounted on 1/2" brass pipe extension 3" long—longer extension if desired.



"Bull Dog"

Insulator Support

"Bull Dog" Supports are safe and efficient for fastening porcelain or glass insulators to exposed steel framework. Four sizes, from 1" to 2 1/2".



No. 471 "Latrobe"

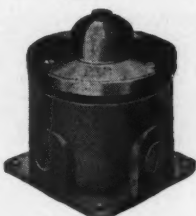
Pipe or Conduit Hanger

Of highest grade malleable iron, and cadmium plated, the No. 470 is unexcelled for hanging 1/2", 3/4" and 1" pipe or conduit to steel beams up to 3/8" thick.

THE COMPLETE LINE

"Latrobe" products offer the complete line of adjustable and non-adjustable, single gang and multiple gang, watertight floor boxes—and all allied products.

"Latrobe" products are easy to install. They are adaptable, economical and thoroughly dependable.



No. 150 Box—
No. 207 Nozzle

Adjustable and watertight for installation in concrete or wood-finished concrete floors. Furnished with 4/4" Cover Plate No. 242 and large Adjusting Ring No. 215.



"Bull Dog"

BX Cable Staples

Millions of these high quality, dependable staples are now in use. Packed in cartons, kegs or barrels.



No. 110 "Latrobe"
Watertight Box

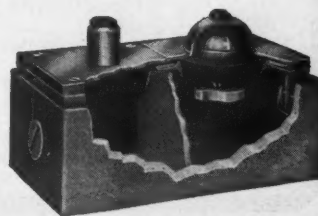
This non-adjustable, watertight Box is extremely simple in design, making for speedy installation and trouble-free service. 208 Receptacle. Cover plate 3 1/2" diameter.

Sold Only
Through
Wholesalers



No. 284 Nozzle with
No. 200 Cover Plate

Neat, compact-fitting, and extremely durable, this Duplex Receptacle Nozzle is furnished with either 1/2" or 3/4" brass pipe extension.



No. 252-R Two Gang Box

This Two Gang Adjustable Box has our No. 208 Receptacle in one section. One cover plate has 1/2" Flush Brass Plug; other has 2" Flush Brass Plug.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

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For TIME SWITCHES



...and get these important advantages

- Proper types for all applications.
- Operated by precision Telechron* motors.
- Expert assistance in application problems, backed by years of experience.
- Convenient sales and service facilities.

FOR LIGHTING CONTROL—TYPE T-27

Wide adaptability, low-cost installation and maintenance make the T-27 (shown above) suitable for all general-purpose applications.

Completely automatic control requiring no manual adjustment after initial setting.

Simple design, meaning fewer parts to wear—fewer places for trouble.

Easy to handle—hinged cover, plenty of wiring space, five standard knockouts for conduits.

**Reg. U.S. Pat. Off.*

LIGHTING JOBS THE T-27 CAN HANDLE

- Spectacular sign displays
- Street lighting circuits
- Floodlighting of construction projects and amusement areas
- Floodlighting of buildings and monuments
- Store- and show-window lighting for after-dark displays
- Electric signs and billboards
- Airport lighting
- All-night lighting in apartment houses

An astronomic dial is available for dusk-dawn schedules—particularly popular for illumination of signs, billboards, and street lights. An omitting device can be furnished for omitting operation on any desired days of the week. For further information, call your nearest G-E apparatus office, distributor, or agency, or write for Bulletin GEA-3339. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

MANUFACTURERS NEWS

G-E APPOINTMENTS

Responsibility for General Electric Company policy pertaining to Employee Relations has been assigned to L. R. Boulware, a vice president of the company.

E. D. Spicer, vice president formerly charged with this responsibility in the organization, will henceforth be in charge of the company's manufacturing policy, continuing as a member of the president's staff.

Major changes in the home office sales organization of General Electric Lamp Department, have been announced by M. L. Sloan, G-E vice president and general manager of the company's lamp department.

Included in the changes are the discontinuance of the department's Eastern and Western sales divisions in favor of two newly created sales divisions. One of these is called general sales division; the other, sales operation division.

N. H. Boynton, who has served as general sales manager of the G-E Lamp Department's Western sales district since 1931, will join the staff of the Administration Division at Nela Park.

P. D. Parker, general sales manager of the lamp department's Eastern sales



N. H. BOYNTON



P. D. PARKER

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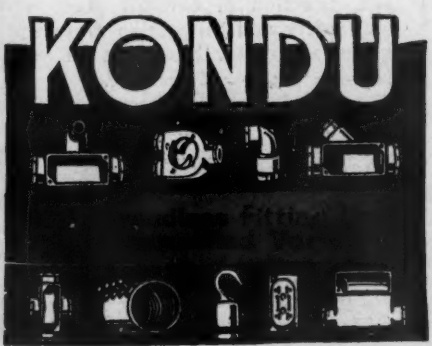
THEY'RE
ALL ALIKE

in 2 Important Ways!
Every KONDU Fitting



Only with **Kondu** can you take one fitting out of the line and put in another, without disturbing conduit . . . or put up conduit before the fittings are delivered. Only with **Kondu** can you use either standard conduit or thin-wall, at any outlet. **Kondu** fittings are vibration-proof. Practically unbreakable . . . 100% re-usable. Write for the **Kondu** Catalog.

KONDU CORPORATION, Erie, Pa.
KONDU MFG. CO. LTD., Preston, Ontario



pure carbon
brushes

SPECIALLY MADE
FOR
SPECIFIC NEEDS



The carbon brush your motor needs for efficient operation depends upon all the circumstances which surround its use. Just any brush won't do. Pure Carbon engineers are specialists in developing carbon brushes for individual applications to fit all operating requirements.

Pure Carbon approaches your problem with a background of more than 30 years' experience. You can take advantage of this knowledge and skill without cost or obligation. Simply write us, giving full details of your need.

PURE CARBON CO., INC.

444 HALL AVE.

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SPEED!

BECAUSE THE
CUTTING EDGE
is
KENNAMETAL



TRADE MARK
REG. U.S.
PAT. OFF.

Kennadrills have cutting tips of Kennametal cemented carbide—the metal that is far harder and more durable than tool steel. No starting punch needed—Kennametal tip takes hold readily, drills fast, retains sharp edge under heat and abrasion of cutting. Design assures clean, accurate drilling in all types of masonry. Can be used in any rotary electric drill. Available in sizes for drilling holes: $\frac{1}{8}$ ", $\frac{3}{16}$ ", $\frac{1}{4}$ ", $\frac{5}{16}$ ", $\frac{3}{8}$ ", $\frac{7}{16}$ ", $\frac{1}{2}$ ", $\frac{5}{8}$ ", $\frac{3}{4}$ ", $\frac{7}{8}$ ", 1 ", $1\frac{1}{8}$ ", $1\frac{1}{4}$ ", and $1\frac{1}{2}$ ".

Distributors Wanted
KENNAMETAL Inc., LATROBE, PA.

KENNADRILLS
DRILL MASONRY FASTER, CHEAPER, EASIER

Mr. Contractor:

IT'S EASY TO SELL **INTER-MATIC** TIME SWITCHES

GET MORE
PROFITS from
YOUR POULTRY

with *Controlled
Lighting*



*After Sundown
LIGHTING
INCREASES
WINDOW-SHOPPING SALES*

LOBBY, HALL, STAIRWAY
and YARD LIGHTING
INSURANCE

NO. 75-41
INTERNATIONAL REGISTER
COMPANY

Policy issued
ability due to
by original
yearly.

Address
to your
PLEASE RE

**POLICE
WITH
LIGHT**

KEEP LIGHTS BURNING
TO
WARD OFF PROWLERS

by using these attractive **SALES HELPS**

—which can be used as self mailers and envelope stuffers for distribution to all classes of prospects. They are designed to make sales and include order blank and space for name and address.

• GET MORE PROFIT FROM YOUR POULTRY

This bulletin tells the poultry farmer the story of "Summer egg yield" all through the winter by means of automatically controlled artificial lighting.

• AFTER SUNDOWN LIGHTING

This attractive circular shows merchants how to increase sales by lighting show windows and signs during the evening window-shopping hours.

• APARTMENT HOUSE LIGHTING

This powerful sales message in the form of an insurance policy sells the apartment building owner on the need and saving of automatic light control for lobby, hall, stairway and yard lighting.

• POLICE WITH LIGHT

This folder is directed to the great home market. It tells why every home should have a time switch to turn lights on at dusk to simulate occupancy and thereby ward off burglars.

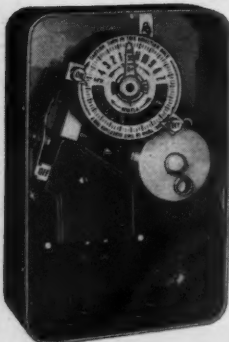
WRITE FOR SAMPLES

of any or all of these helps and the name of the Inter-Matic Distributors in your territory.

NO COST — NO OBLIGATION

Ask for Full Information on the

INTER-MATIC



115 V., 60 C.

\$9.00
LIST

50 cycle — \$9.19
25 cycle — 9.32

F.O.B. Chicago

INTERNATIONAL REGISTER CO.

Dept. 87B, 2624 West Washington Blvd., Chicago 12, Illinois

division since March, 1945, becomes general sales manager of the general sales division in the new sales setup.

Fred J. Borch, manager of the general service division, is appointed manager of the newly created sales operation division.

D. A. Hopper, who for the past two and a half years has served as manager of the Newark service district at Newark, N. J., will succeed Mr. Borch as manager of general service division.

J. A. Ampert, manager of St. Louis Service district, is appointed manager of Newark service district. O. E. Bruton, manager of Denver service district, is named manager of St. Louis service district. R. G. Weiland, assistant to the manager at Atlanta service district, has been made manager of Denver service district.

W. A. D. Evans, for six years consultant on electrical discharge lamps in the Administration Div., retired on July 1 after 29 years of service.

Frank A. Stortz, Jr., former heating appliance sales representative in San Francisco, has been appointed sales manager of G-E's Fan Division.

The appointment of James A. O'Donnell as district representative for G-E conduit products in the Great Lakes district has been announced. His headquarters will be in Cleveland.

W. R. Becker has been named product promotion manager of G-E wiring device sales.

Kenneth D. Sargent has been made district representative for G-E wiring devices in the central district.

WESTINGHOUSE APPOINTMENTS

Appointment of R. D. Duthie, of Chicago, Ill. as assistant to the vice president, Westinghouse Electric Corporation has been announced. He will head the company's chain store activities and will be located in Pittsburgh. He succeeds A. J. Bronold, who has been transferred to the company's B. F. Sturtevant Division in Boston, Mass., as general agency and contractor manager.

N. H. Callard has been named manager of Rural Electrification, industry sales department. His headquarters will be at East Pittsburgh, Pa.

T. O. Armstrong has been appointed director, Plant Labor Relations. He will be responsible for the coordination and direction of over-all plant training, safety and suggestion system programs and research work in the field of labor relations and training.

Announcement has been made of the appointment of Clifford M. Sayre as general works manager of the Sturtevant Division.

Dr. Harvey C. Rentschler retired on July 1 after a 30 year career of directing Westinghouse lamp and electronic tube research at Bloomfield, N. J.

Frank A. Newcombe, manager of parts manufacturing for the Westing-

**It's Profitable
It's Practical
TO WIRE**

The P&S-DESPARD Way



Why limit the usability of an electrical outlet by installing one old-fashioned device to a gang? With the flexibility of the P&S-Despard Line, literally thousands of practical combinations can be installed in single switch boxes—two or three switches—switch and outlet (or outlets)—pilots, night lights. Make every electrical outlet do double or triple duty—create a wiring job that is practical for the customer—profitable for you.

Send for complete information.

PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK

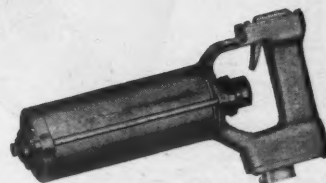
**Save Money and Time
with**

SYNTRON

DEPENDABLE

ELECTRIC HAMMERS

**3600 Powerful,
Hard-Hitting**



Blows per Minute—Speed Up

Drilling—Cutting—Chipping in concrete and masonry

SYNTRON'S patented electromagnetic principle uses only one working part—the PISTON—producing high speed, hard-hitting blows that cut down job time.

Write for illustrated folder

SYNTRON CO.

690 Lexington, Homer City, Pa.



For Performance!



Licensed under
U. S. Pat.
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Others Pending

**MAGNO-TRONIC
DUAL SILVER POINT
ELECTRODYNAMIC
FLUORESCENT STARTER**

A precision built instrument of established merit incorporating the following features—starting reliability coupled up with a fully automatic circuit breaker that will cut out a de-activated tube from the circuit—no manual reset required to allow starter to perform all of the lamp starting functions when a good lamp is installed. Contacts are made of noble metal assuring longevity, durability and economy.

You'll find Industrial Electronics Corporation products in factories, office buildings, stores, railroad terminals, shipyards, schoolrooms . . . everywhere contributing to the comforts of American Life.

The (SP-15-20) for use with either 15 or 20 watt lamps

The (SP-30-40) for use with either 30 or 40 watt lamps

The (SP-100) for use with 100 watt lamps

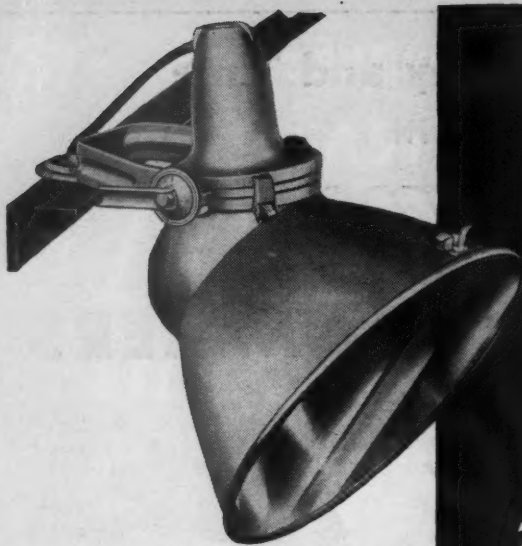
Ask for descriptive literature

INDUSTRIAL ELECTRONICS CORP.

80 Bank Street



Newark, N. J.



Type L-69, sports and area floodlight

Call for FLOODLIGHTS

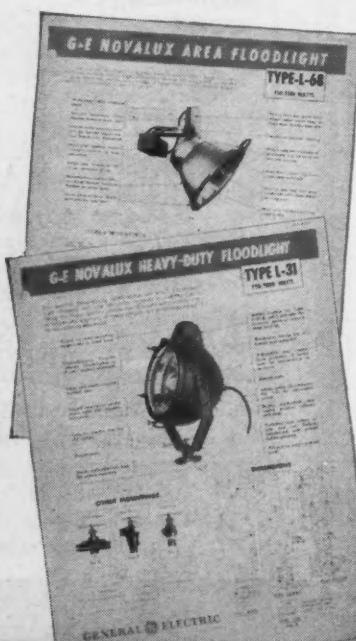
... and get these
important advantages

- ★ Proper types and sizes for all applications
- ★ High-efficiency, the result of scientific design
- ★ Long life and low maintenance expense
- ★ Expert assistance with application problems, backed up by 30 years' experience
- ★ Convenient sales and service facilities

WANT THESE HANDY DESCRIPTIVE LEAFLETS FOR YOUR PROPOSALS?

FLOODLIGHT	PUBLICATION
Heavy-duty, steel casing	
200 or 250 watts, Type L-29	GEA-4303
300 or 500 watts, Type L-30	GEA-4304
750 or 1000 watts, Type L-31	GEA-4305
Heavy-duty, cast aluminum	
1000/1500 watts, Type L-34	GEA-4517
200 or 250 watts, Type L-38	GEA-4325
General purpose, sheet aluminum	
300 or 500 watts, Type L-49	GEA-4311
750 or 1000 watts, Type L-43	GEA-4310
Sports and area, sheet aluminum	
750 to 1500 watts, Type L-68	GEA-4333
750 to 1500 watts, Type L-69	GEA-4590
Area, open porcelain enamel	
300 to 1500 watts Type L-45	GEA-4433
300 to 1500 watts Type L-46	GEA-4434
Handy, sheet aluminum	
100/150 watts, Type L-65	GEA-4516
200 watts, Type L-66	GEA-4346
Underwater, cast bronze	
100/250/400 watts, Type L-33	GEA-4438
500/1000 watts, Type L-39	GEA-4518
500/1000/1500 watts, Type L-41	GEA-4439

Order individually by number, or in sets, from the G-E Apparatus Sales Office or Agent that serves you. Or write General Electric Company, Schenectady 5, N. Y.



GENERAL ELECTRIC

house Lamp Division, Bloomfield, N. J. has been appointed manager of the incandescent lamp plant which the company will build in Little Rock, Ark. Hans N. Horst, assistant superintendent of the Lamp Division's Fairmont, W. Va. Works, was named assistant manager of the new plant.

Ira G. Deitrick, formerly Pittsburgh metropolitan manager for the Westinghouse Lamp Division, has been appointed syndicate manager for the New England district.

Walker G. White and Harry W. Tenney have been appointed operating managers of the Westinghouse Electric Elevator Division, at Jersey City, N. J.

SHULL ELECTRIC PRODUCTS CORPORATION ORGANIZED

The Shull Electric Products Corporation of Arlington, Va. is the successor of an old and well known Washington concern known as The Shull Company, which served the electrical industry in that area for approximately 40 years.

The officers of the new corporation are Frank T. Shull, president; Thomas S. Shull, vice president and Richard C. Lipps, secretary. Mr. Lipps was formerly affiliated with Trumbull Electric Manufacturing Co.

Lee W. Charter has recently resigned his position with the National Office of the Housing Expediter in Washington, D. C. to become affiliated in an executive capacity with this organization. He will devote his activities to production phases of the company.

WESTINGHOUSE SUPPLY CHANGES

Announcement has been made of the appointment of Mervy W. Jewell, as Central New York State District Stores Manager of the Westinghouse Supply Co., with headquarters in Rochester, N. Y. Mr. Jewell was formerly assistant to general stores manager at Wesco Headquarters, 40 Wall Street, New York City.

E. W. Gaughan has been appointed general farm sales manager of Wesco, reporting to Mr. Urban, general appliance manager.

EDWARDS & COMPANY CHANGES

Edwards and Company, Inc., of Norwalk, Conn. has announced the following changes in their sales personnel:

C. H. Holden has retired on pension, having been in the employ of the company for 30 years.

R. H. Andrews has been transferred from district manager of the Philadelphia district to managing director

WE BUILT A BETTER



ROTARY CONCRETE DRILL

COME ON NOW AND BEAT
A PATH TO OUR DOOR . . . !

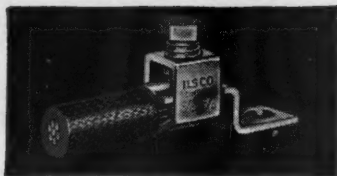
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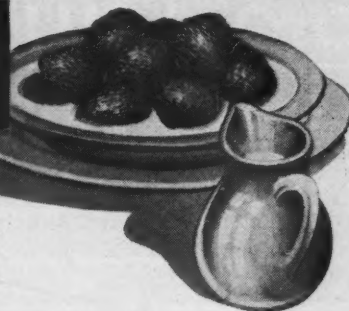
STRONGER PRESSURE . . .
because deep boss
provides more threads.

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STRAWBERRIES

without cream? . . . a mis-
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leads, circuits, relays, parts, etc. • As alert pro-
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Wisconsin.**



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Please send me **FREE** samples of **QUIK-LABELS**, the modern time and
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All Slater units reflect the quality that has earned them the name of "Lifetime" Wiring Devices. Their design, material and workmanship rate high in customer satisfaction. You can recommend a Slater product for any application—with confidence that it will give quality performance.

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T-Rated: 10 Amps-125 V.
5 Amps.-250 V.

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Available in Ivory

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Brown Bakelite
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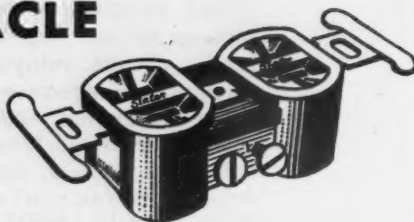
Side Wired

Rating: 15 Amps—125 V.

10 Amps—250 V.

No. 300 Brown Bakelite

No. 300-I Ivory Bakelite



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REPRESENTATIVES IN PRINCIPAL CITIES

of Edwards of Canada Limited, in Montreal.

R. B. Shannon has become manager of the Philadelphia district. He was formerly in the Brooklyn-Long Island-Staten Island-Northern New Jersey District.

S. A. Kennedy succeeds Mr. Shannon in the Brooklyn-Long Island district.

E. A. Harris has been appointed supervisor of the sales office in Norwalk.

U. S. RUBBER APPOINTMENTS

Richard B. Carland has been appointed sales promotion manager of the wire and cable department of United States Rubber Company, with headquarters in the company's general offices, 1230 Avenue of the Americas, New York.

George E. Hubrig has been named southwestern district engineer of the wire and cable department, with headquarters in Kansas City.

NELSON ELECTRIC OFFICERS

A. L. Nelson, President, Nelson Electric Corporation, 1620 Euclid Street, Santa Monica, Calif., has announced the appointment of the executive personnel and board members of the recently organized corporation. George Otis has been named vice president and director; Daniel W. Gage, secretary, director and corporation counsel; Jack D. Phelan, sales manager and director; Eugene Leitner, treasurer; Henry Butz, chief engineer.

Carl C. Nelson, works manager in charge of factory production, and James DeKiep, chief engineer, have been named to the board of directors of the Electric Machinery Mfg. Company, Minneapolis, Minn.

Burlington Instrument Company of Burlington, Iowa, has announced the appointment of the following representatives:

Ernest G. Hendrickson, 227 East Sprague Avenue, Spokane, Wash., will cover the states of Montana and Idaho and that part of the State of Washington east of and including the counties of Okanogan, Douglas, Grant and Benton.

Forrest C. Valentine, 912 Fort Wayne Bank Bldg., Fort Wayne, Ind. has the states of Indiana and Kentucky, state of Ohio south and west of and including the counties of Darke, Shelby, Champaign, Madison, Franklin, Pickaway, Ross, Pike and Scioto.

White Sales Company, 10 High Street, Boston, Mass. will cover the states of Connecticut and Rhode Island.

AEMCO Automatic TIME SWITCHES

of precision

- Synchronous
- Manually Wound

Stock Models from 1100 to 4950 Watts per pole.

CHECK THE Automatic LINE

For any load . . . for every installation, there is an Automatic Time Switch to meet the most rigid specification. Compact, ruggedly constructed Automatic Switches have pure silver contacts . . . tamper proof cabinets with visible dial . . . 2 to 24 "on" and "off" operations. For dependable automatic time switches specify Automatic.

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ROTARY DRILL MASONRY 4 TIMES FASTER

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Drills Fit Any
Rotary Drill,
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Drill Press

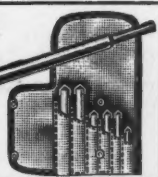


- Stay Sharp up to 50 Times Longer
 - Cut Clean-Edged Holes Close Together Without Break-Through
 - Drills Concrete, Brick, Plaster, Slate
- Tips of the hardest metal made by man, set in solid round shanks, make Carboloy Masonry Drills superior tools for drilling holes for expansion anchors, etc. Faster drilling, 50 times longer life means vast savings in time and money.

15 POPULAR SIZES IN ALL

Handy 6-drill set—3/16", 1/4", 5/16", 3/8", 1/2" and 5/8", only \$13.70—in free canvas kit.

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(TRADEMARK) CEMENTED CARBIDE
MASONRY DRILLS

Bend Conduit Cold-Here's How



Conduit can be bent



to any desired angle



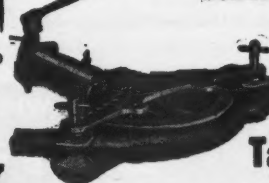
without moving pipe



in one operation

Installation work goes faster, easier, and at a lower cost when you have a Tal's Prestal Bender on the job. This efficient, light, portable machine handles all pipe and conduit up to 3". Makes perfect bends, up to 90°, cold, in one single operation. No need to waste labor by replacing the pipe three to six times to make a bend. Does a good workmanlike job — smooth, uniform bends without kinks or wrinkles.

Simple and easy to operate. Thousands are in successful use everywhere. Write for data bulletin.



Tal's Prestal Bender, Inc.

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PORTABLE,
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STATIONARY

You can simplify any power-for-electronics problem with an ONAN Electric Plant. A wide range of models and sizes makes it easy to choose the right plant for the particular application. Lightweight one or two-cylinder air-cooled models for easy portability—A.C.—350 to 5,000 watts, D.C.—600 to 5,000 watts. Onan two, four and six-cylinder water-cooled models are built for continuous heavy-duty operation, stationary or mobile. A.C.—3,000 to 35,000 watts, D.C.—3,500 to 10,000 watts. ONAN Electric Plants: A.C.—350 to 35,000 watts in standard voltages and frequencies. D.C.—400 to 10,000 watts, 115 and 230 volts. Battery chargers—500 to 4,000 watts, 6 to 115 volts.

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Complete with receptacle, two 5-foot chains, "S" hooks and cord clips. Fits standard 4" or 3 1/4" outlet box or plaster ring. Self-grounding—regular 2-wire cord and plug may be used. **\$1.65** each list

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In Canada: address all inquiries to Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

*Patent No. D-141024, others pending. Underwriters approved.

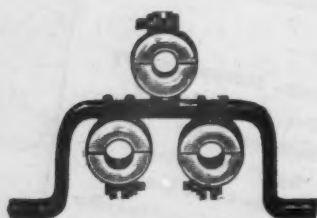


IT'S EASY TO SEE WHEN IT'S

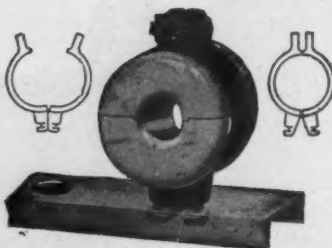
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Lighting

"EFFICIENCY" DEVICES FOR CONDUIT AND CABLE SUSPENSION

**EFFICIENCY
NESTED
CONDUCTOR
RACKS**



Nested Conductor Racks available for Cable diameter from 5/16" to 2 3/8".



• Simplicity is keynoted in the design of the EFFICIENCY bushing rack. Note that a single bolt supports the bushing and at the same time clamps the bushing support to the rack. Each fitting is a separate unit . . . permits the installation of each cable independently.

The EFFICIENCY rack is constructed of standard rolled steel channel—sizes according to size of bushings and number of mountings for each rack. Bushing supports are malleable iron. For A.C. service a brass half is furnished. Bushings are glazed porcelain, extra large and heavy.

Complete information on all EFFICIENCY Electrical Devices is available. Write today for your copy of Catalog No. 38A.

Efficiency
ELECTRIC AND MANUFACTURING CO.



MANUFACTURERS OF EFFICIENCY
ELECTRICAL DEVICES FOR CONDUIT
WIRE AND CABLE SUSPENSION

The Wiremold Company of Hartford, Conn., has announced the appointment of Robert T. Bennet as New England district sales manager with offices at 10 High Street, Boston, Mass. He will cover Maine, New Hampshire, Vermont, Massachusetts and Rhode Island.

Solar Manufacturing Corporation and its subsidiary, Solar Capacitor Sales Corp. has moved its general offices to its main Eastern plant at 1445 Hudson Blvd., North Bergen, N. J. The offices were formerly located at 275 Madison Ave., New York, N. Y.

The Spero Electric Corporation of Cleveland, Ohio, announces the appointment of Ben K. Patton, Box 834, Gulfport, Miss., as manufacturer's agent to cover Mississippi, Louisiana, Arkansas and Western Tennessee.

C. M. Waite, formerly with Wm. Wurdack Electric Manufacturing Company of St. Louis, is now connected with the Lowry Electric Company, electrical contractors of East St. Louis, Ill.

Walter R. Bullock of Boston, Mass., has recently been appointed district representative for the New England States by Solar Electric Corporation of Warren, Pa.

The Okonite Company, Passaic, N. J., has opened a new sales office in Cincinnati, Ohio. This branch, located at 516 Building Industries Bldg., 626 Broadway, Cincinnati 2, is in charge of S. W. Pollock.

F. R. Archer has been named merchandising supervisor of the Fluorescent Lighting Fixture Division of Sylvania Electric Products Inc.

The Emerson Electric Mfg. Co. of St. Louis, has moved its Detroit district office to new quarters at 1375 East Jefferson Ave., Detroit 7, Mich.

C. H. Smith, operating as Industrial Products Co., Pittsburgh, is now representing The Adalet Manufacturing Co., Cleveland.

American Relay and Controls, Inc., have moved into larger quarters at 2555 Diversey Avenue, Chicago.

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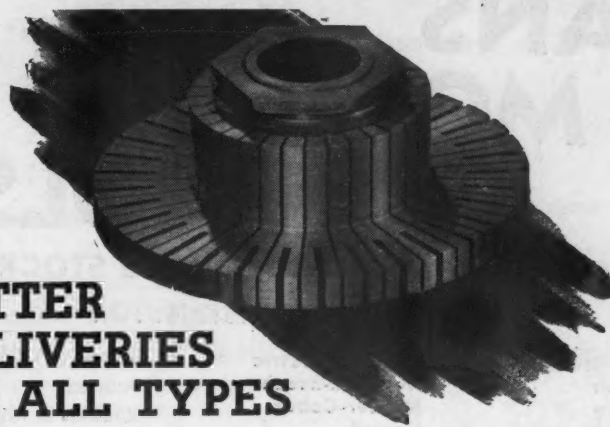
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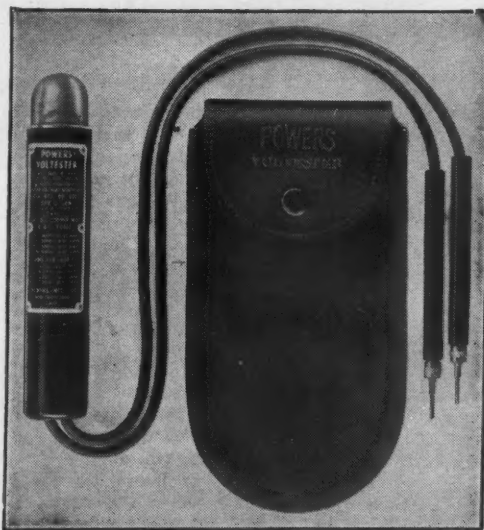
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CATALOG NO. E 112

is a practical tool for ordinary voltage testing. It is equipped with a six-watt Mazda lamp (not a neon lamp) which will tell you positively at a glance whether the circuit is HOT and HOW HOT.

You should know if you are working on 110-220-440 or 550 volts. A POWERS VOLTESTER tells you definitely. You need no light to read the voltage shown with this tester. It tells you by the brilliancy of it's own light what voltage you are on.

If you must know the exact voltage reading use a Volt Meter. But for practical testing use a POWERS VOLTESTER.

Sold Only Through Distributors

LIST PRICE WITHOUT LEATHER CASE.....5.20

LIST PRICE WITH LEATHER CASE (Attachable to belt).....6.60

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Peerless
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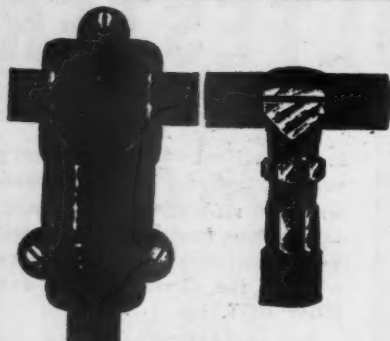
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Parts Distributors for the Manufacturer

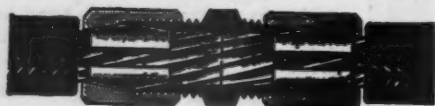
200 William St.

Barclay 7-6616

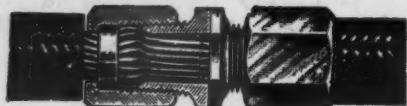
New York 8, N. Y.



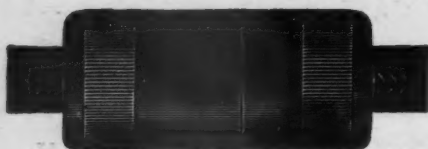
Type DHT



Two-Way Type "A" Construction



Two-Way Type "B" Construction



Two-Way Cover Type TWC

DOSSERT CONNECTORS

TYPE DHT

A hook type cable tap connector. The contact surface of the hook section and the compression gland are accurately machined to fit the conductor run, while the tap off section is available in the type "A" or type "B" construction illustrated below. This connector is available with an insulating cover for making compact insulated connections as illustrated.

TYPE TW

A two way connector for coupling cables on end. Available in the type "A" or type "B" construction as illustrated. The type "B" construction develops many times the tensile strength of the conventional fitting. For instance with a 500MCM cable the tensile strength is 5,350 lbs. Both connectors are available with insulating covers type TWC to make an insulated joint as illustrated.

Send for literature on the type "B" construction which outlines comparative strengths and cable anchor applications.

"INSIST ON GENUINE DOSSERTS"

DOSSERT MFG. CORP.

249-253 HURON ST.
BROOKLYN 22, N. Y.

THE CODE ON SIGNALS

[FROM PAGE 43]

not exceed 30 volts, the branch circuits (section or point wires) need not be individually fused provided the main or feed wire is properly fused in accordance with the requirements of the code.

4. Class 1 remote control and signal circuits need not be grounded unless supplied by a separate control transformer from a system having a nominal voltage to ground of more than 150 volts.

5. The number of Class 1 remote control or signal circuit conductors that may be run in a single conduit are not limited. (Official Interpretation No. 283).

The Class 1 and Class 2 circuits of the new Article 725 in the 1947 Code replace the Class 2, Class 3 and Class 4 circuits of Article 800 in the 1940 edition of the Code. The requirements for the Class 2 circuits in both the 1940 and 1947 editions of the Code are basically the same, however, Class 2 of the 1947 Code is more liberal in that it permits the use of circuits operating up to 150 volts, where the 1940 Code limited Class 2 circuits to 60 volts.

The Class 1 circuits of the 1947 Code replace the Class 3 and Class 4 circuits of the 1940 Code. The new Class 1 is considerably more liberal than either Class 3 or Class 4 of the 1940 Code. Class 3 of the 1940 Code limited the rating of the power supply to 1 kw. maximum, while Class 1 in the 1947 Code places no limit. Class 4 of the 1940 Code did not permit the use of No. 18 or No. 16 conductors or the use of more than 9 conductors in a single conduit. Both of these are permitted in the new Class 1 of Article 725.

The Revised Article 800 of the 1947 Code is entitled "Communication Systems". This article applies to the wiring of the following equipment:

- Fire Alarm Systems
- Watchman's Systems
- Burglar Alarm Systems
- Sprinkler Alarm Systems

The Revised Article 800 of the 1947 Code replaces the Class 1 system of Article 800 in the 1940 Code, and there has been little change as it applies to the above listed systems other than the new title.

It is well to note that the revised Article 800 does not specify the size



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STATOR HOLDER

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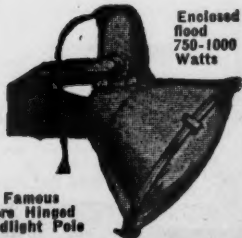


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Revere Engineers keep in mind the man who installs and maintains when designing lighting units. Simplicity of design, ease of wiring with a minimum of maintenance are the factors that find favor with Contractors everywhere. Adaptability plus exclusive features help contribute to the high rating of Revere lighting units.



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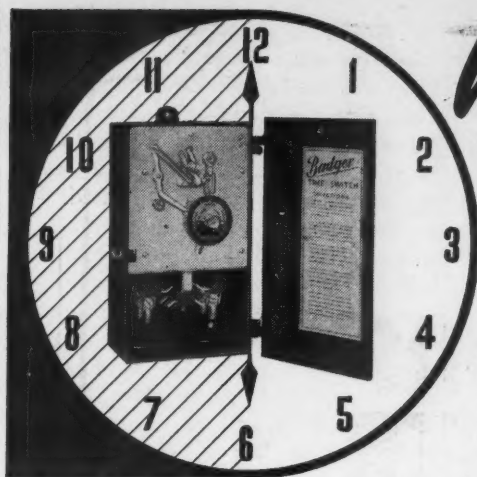


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- Plain or Astronomic
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● Reliance Time Switches—our customers tell us—are well-named. Many say our standard electric time switches meet practically all of their automatic control requirements. Some users have enjoyed dependable Reliance service for more than 35 years. You, too, can rely on the Reliance line. Ask your distributor or write—Reliance Automatic Lighting Co., 1937 Mead St., Racine, Wisconsin.



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IN THE SPOTLIGHT



TOUGH
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WEATHERPROOF
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LESS REPLACEMENTS

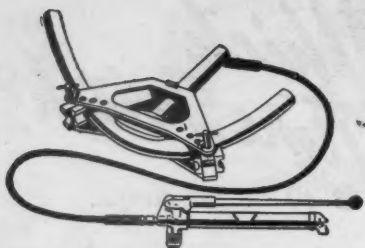
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Install this socket where toughest conditions prevail. You will then be convinced that you should standardize on the 63310.

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WORKS AT ALL ANGLES



✓ The compact hydraulic Porto-Power Ram is all-directional. Power eliminates need for heating the pipe.

WORK OVERHEAD



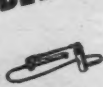
✓ All-directional operation and light weight enlarges range of utility to use on ladders, scaffolds and cramped quarters and work on existing pipe runs.

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✓ Remote control permits operator to stand in any position for a full view of the job. Saves need for elbows, couplings, cutting and extra threading.

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✓ It pulls gears, lifts machinery, and licks scores of other trouble jobs.

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of wire or type of insulation to be used, nor does it state that wires must be run in conduit. It does state, however, that the wires of the communication system shall not approach nearer than 2 in. to any electric light or power wires unless separated by a continuous non-conductor in addition to the insulation on the wires. (This ruling refers particularly to old buildings having knob and tube type light and power wiring). Further, the wires of the communication system shall not be placed in the same raceway, compartment, outlet box, junction box or similar fitting with conductors of Class 1 remote control and signal circuits or light and power circuits, unless the conductors of the two systems are separated by a partition, except in such cases where the light and power wires are introduced solely for power supply to the communication system. It can be assumed that the wires of a low-tension communication system may occupy the same conduit or compartment with wires of a Class 2 remote control or signal circuit.

We wish to point out that Article 800 covers only the general requirements for communication systems. For detailed requirements pertaining to fire alarm systems, watchman's systems, burglar alarm systems and sprinkler alarm systems, it is necessary to refer to National Board of Fire Underwriters' Pamphlet Nos. 71, 72 and 13. Pamphlet 71 covers the standard for central station systems; Pamphlet 72 covers proprietary, auxiliary and local systems; and Pamphlet 13 covers sprinkler equipment. Pamphlet 13 states that the wiring of a sprinkler alarm system shall be in accordance with Pamphlet 72. Both Pamphlet 71 and Pamphlet 72 state that the inside wiring shall basically be as outlined in Chapter 3 of the National Electrical Code, which covers light and power wiring. For further details, we suggest that you consult these Pamphlets with special reference to paragraph 224, page 13 of Pamphlet 71, and paragraph 223, page 8 of Pamphlet 72.

Since the requirements of the National Board of Fire Underwriters' pertaining to signal systems have now been condensed and simplified to include only 2 classifications of signal systems, namely: Class 1—systems in which the current is not limited with wiring in conduit and Class 2—systems in which the current is limited permitting open wiring, it should now be a simple matter for all of us to become well versed on the standards pertaining to signal circuits.



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